ENHANCING CAPACITY FOR LOW EMISSION DEVELOPMENT STRATEGIES (EC-LEDS) CLEAN ENERGY PROGRAM

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Sustainable Energy Action Plan for Batumi

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Sustainable Energy Action Plan for Kutaisi

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Submitted to: Nick Okreshidze, AOR
US Agency for International Development
USAID/Georgia

Submitted by: Dana Kenney, COP
Winrock International - Georgia
EC-LEDS Program
7, I. Chavchavadze Avenue
Tbilisi, 0179, Georgia
+995 32 250 63 43
www.winrock.org

TABLE OF CONTENTES

List of Tables vi
List of Figures viii
Acronyms ix
Introduction – The Covenant of Mayors and Batumi City 11
Batumi City – Brief Overview 11
Sustainable Energy Development Strategy 17
Summary of Batumi's Sustainable Energy Action Plan 20
Transport 24
Sector Overview 24
Methodology 27
Base Year Inventory and Greenhouse Gas Emissions Baseline Scenario (2013-2020) 30
Batumi Transport Sector Emissions Reduction Action Plan 33
Detailed description of activities 35
Activity PB1. Public Transport Management 35
Activity PB1. Introduction of Electric Taxis 37
Activity UP1. Rehabilitate and develop transport infrastructure through the following activities 37
Activity UP2. Facilitate Cycling and Walking 39
Activity PRT1. Parking System Development 41
Buildings 44
Sector Overview 44
The Batumi Residential Buildings Sector 45
Current State of the Buildings Sector 48
Measures implemented in the buildings sector 48
Total Energy Consumption in Batumi 51
Methodology 51
Base Year (2012) Inventory and GHG Gas Emissions- BAU Scenario (2013 – 2020) 54
GHG Emissions Reduction Action Plan from Batumi Buildings Sector 55
Detailed Description of Measures 71
Measure MB 1.1. Thermal insulation of ceilings and walls in municipal buildings (10, Sulkhan-Saba Orbeliani St.) 71
Measure MB 2.1. Fluorescent lighting systems in kindergartens 71
Measure MB 3.1. - Thermal insulation of a roof and walls in a kindergarten at 4a, Inasaridze St.) 72
Measure MB 4.1. Utilization of Solar Collectors in Kindergartens 72
Measure RB 1.1. – Install one energy-efficient bulb in each flat of 7 residential buildings 73
Measure RB 2.1.- Heat Common Spaces in 7 nine-storey residential buildings 73
Measure RB 3.1. - Develop a biomass high efficiency heater for private houses 74

Public lighting 76
Overview of the Sector 76
Methodology 77
Inventory of Baseline Year 77
GHG Emissions for the BAU Scenario (2013-2020) 77
Action Plan for Mitigation of the Emissions from Batumi Public Lighting 78
Solid waste and wastewater 79
Overview of the sector 79
Solid waste 79
Wastewater 81
Methodology 82
Solid waste 82
Wastewater 83
Baseline year inventory and GHG emissions baseline scenario (2012-2020) 84
Solid waste 84
Wastewater 86
Action Plan for the reduction of emissions from Batumi solid waste and wastewater sector 87
Creating methane extraction and on-site flaring or utilization system at the new Ajara landfill 88
Modernizing the Batumi wastewater purification system 88
Greening 91
Overview of the sector 91
Methodology 91
IPCC Methodology 92
CO2FIX V 3.1Model 92
8.3 Base year inventory 93
Batumi Greening Action Plan 102
Soil Module 103
The impact of training and awareness raising of Batumi society and target groups on the perspectives of sustainable energy development and its economic and social results 106
Monitoring, verification and reporting implementation of the Sustainable Energy Action Plan (SEAP) and GHG emissions 114
Responsible Unit in the Municipality 115
Monitoring Reference Scenario Drivers 117
Emission Factor (EF) 118
Data to be monitored for the transport sector of Batumi city 119
Data to be monitored for public buses 119
Mini Buses 122

Private cars 124
Municipal cars and other cars used by governmental structures 125
Commercial transport (taxi, light-duty and heavy-duty vehicle) 127
Waste management and wastewater treatment 129
Street lightening 136
Green spaces of Batumi city 137
Building sector 139

LIST OF TABLES

Table 1. GHG Emissions in Batumi in 2012 and 2020 (tons CO2 eq.) 20
Table 2. Emissions savings in different sectors according to Batumi SEAP 21
Table 3. Registered vehicles in Batumi (cars) 25
Table 4. Vehicles registered in Batumi (public transport) 26
Table 5. Vehicles for public transport inside the city 26
Table 6. Vehicles registered (commercial transport) 27
Table 7. Characteristics of Batumi transport 27
Table 8. Distribution of urban and rural travel 27
Table 9. Conversion Coefficients and Carbon Emission Factors for Different Types of Fuel 28
Table 10. Share of Oxidized Carbon in Different Types of Fuel 28
Table 11 .Methane and Nitrous Oxide Emission Factors for Transport Sector (kg/MW.h) 28
Table 12. Methane and Nitrous Oxide Global-Warming Potential (GWP) 29
Table 13. Batumi Transport Sector's Final Energy Consumption (MW.h) – 2012 31
Table 14. Batumi Transport Sector's Greenhouse Gas Emission in CO_2 Equivalent (Ton) – 2012 31
Table 15. Total Pollutant Data and Percentage Difference between 2010 – 2013 31
Table 16. Fuel Consumption Growth Rates for Different Types of Transport under the BAU Scenario 32
Table 17. Transport Sector Action Plan 34
Table 18. Specifications for transfer terminals 35
Table 19. Market share adjustment plan for buses and minibuses 35
Table 20. Public transport optimization-related expenses for 2015-2018 36
Table 21. Batumi local government's initiated and ongoing projects for rehabilitation and improvement of road infrastructure 38
Table 22. Parking fine in Batumi 41
Table 23. Parking measures budget 43
Table 24. Fund of residential buildings of Batumi 45
Table 25. Total number and area of constructions in Batumi 46
Table 26. List of buildings owned by Batumi city municipality 47
Table 27. List of private houses 47
Table 28. List of residential buildings constructed before 2000 47
Table 29. Residential buildings in Batumi according to the data of 2013 48
Table 30. Works accomplished in 2007-2013 49
Table 31. Infrastructure projects planned for 2015 - 2020 50
Table 32. Energy resources consumed by municipal, commercial and residential buildings in Batumi throughout 2012 51
Table 33. Methane and Nitrous Oxide Emission Factors for Buildings (kg/MW/h) 51
Table 34. Total Energy Consumption in Batumi Buildings Sector – 2012 54
Table 35. GHG emissions from Batumi Buildings Sector CO_2 –eq. (t) - 2012 54
Table 36. Fuel Consumption Growth Rates for Different Building Types under the BAU Scenario 55
Table 37. Energy saving and emissions reduction potential in Batumi by building types 63
Table 38. Energy savings and emissions reduction potential by buildings in Batumi 66
Table 39. Emissions Reduction Action Plan for Batumi Buildings 68

Table 40. Profitability parameters of Measure MB 1.1 71
Table 41. Profitability parameters of Measure MB 2.1 71
Table 42. Profitability parameters of Measure MB 3.1 72
Table 43. Profitability parameters of Measure MB 4.1 73
Table 44. Profitability parameters of Measure RB 1.1 73
Table 45. Profitability parameters of Measure RB 2.1 74
Table 46. Profitability parameters of Measure RB 2.2 measure 74
Table 47. Profitability parameters of RB 2.3 measure 74
Table 48. Profitability parameters of Measure RB 3.3 75
Table 49. Energy consumption and spending for street lights in Batumi in 2012 76
Table 50. Types of bulb and energy consumption 76
Table 51 Methane annual production from Batumi old SWDS after its closure 85
Table 52.Methane generation from new SWDS in case of constant annual piling of residential waste amounting to 42 000 ton/yr 85
Table 53. Baseline emissions of methane (BAU scenario) in 2015-2020 from the Batumi (Adlia) wastewater purification facility 86
Table 54.Forecast of methane recovery from wastewater and substituted by clean energy 89
Table 55.Implementation stages and budget for the Adlia wastewater purification facility modernization project 90
Table 56. Average carbon taxation data of the trees/plants for Batumi 96
Table 57. Coefficients used in the calculations and their source 100
Table 58. Carbon dioxide accumulation and expenditure figures on project facilities 101
Table 59. Required and used characteristics in the biomass module according to the project scenario 102
Table 60. Characteristics used in the soil module 103
Table 61. Annual carbon accumulation as a result of the greenery planting on 1 ha in 2014-2019, TC 105

LIST OF FIGURES

Figure 1. Batumi population size (thousands) 13
Figure 2. Structure of the population of Batumi city according to Population Census 2002. 13
Figure 3. Employment rates in Ajara 2000-2010.. 14
Figure 4. Gross Value Added of Ajara and whole region.. 14
Figure 5. GDP of Batumi city by sectors 2010.. 15
Figure 6. Revenues for Batumi city budget 15
Figure 7.Distribution of the budget of Batumi city for 2012, in program profile 2012 16
Figure 8. Distribution of the budget of Tbilisi city by years (thousand GEL) 16
Figure 9. Emission distribution by sectors in the years 2012 and 2020. 21
Figure 10. Increase in emissions according to the BAU and Sustainable Energy Action Plan (SEAP) scenarios in transport sector.. 22
Figure 11. Increase in emissions according to the BAU and the Sustainable Energy Action Plan (SEAP) scenarios in buildings sector.. 22
Figure 12. Increase in emissions according to the BAU and the Sustainable Energy Action Plan (SEAP) scenarios in street lighting sector.. 23
Figure 13. Increase in emissions according to the BAU and the Sustainable Energy Action Plan (SEAP) scenarios in waste sector.. 23
Figure 14. Batumi streets structure 24
Figure 15. Trend of Transport Sector Emissions under the BAU Scenario.. 32
Figure 16. Number of parking fines in Batumi in 2011-2013.. 42
Figure 17. ENSI software format for Energy Budget Article “Heating”.. 53
Figure 18. „Energy Budget“ 53
Figure 19. Trends of Emissions from Buildings Sector According to the BAU 55
Figure 20. Emissions from the street lights sector in 2012 - 2020.. 78
Figure 21. Energy consumption by city streetlights according to the BAU scenario compared to the SEAP activity of light replacement 79
Figure 22. Anticipated trend of waste generation at Ajara’s new landfill 81
Figure 23. Comparison of methane emissions from the Waste sector for BAU scenario and in case the project is implemented.. 91
Figure 24. Schematic drawing of the model structure.. 93
Figure 25. Orthophotograph – Batumi Botanical Garden.. 95
Figure 26. The carbon accumulation and carbon dioxide absorption rates after the planned landscaping.... 104
Figure 27. Accumulated carbon dynamics after cultivation.. 105
Figure 28. Managing the Monitoring Process 116

ACRONYMS

BAU – Business As Usual
BDD – Basic Data and Directions of the country
BRT – Bus Rapid Transit system
C - Carbon
Cd - Cadmium
CDM – Clean Development Mechanism
CH_4 - Methane
Clima East -
CO – Carbon monoxide
CO_2 – Carbon dioxide
$CO_{2\ eq}$- Carbon dioxide equivalent ($CO_{2\ eq}$)
CoM – Covenant of Mayors
Cr - Chrome
Cu - Copper
EC -LEDS -
EU – European Union
EU -COM -
FOD – First Order Decay model
GEF – Global Environment Fund
GIZ –Die Deutsche GesellschaftfürInternationaleZusammenarbeit)
German Society for International Cooperation
IPCC – Intergovernmental Panel on Climate Change
JRC – Joint Research Centre of the EU
MCF – Methane Correction Factor
Mg - Megagram (10^6g = 1t)
N_2O – Nitrous Oxide
NCV – Net Calorific Value
NG – Natural Gas
NH_3 - Ammonia
Ni - Nickel
NMVOC - Non-Methane Volatile Organic Compounds
NO – Nitrogen Oxide
NO_2 – Ditrogen Dioxide
NO_X – Nitrogen Oxides
Pb - Lead
PM – Particulate Matters
QA/QC – Quality Assurance/Quality Control
Se - Selenium

SEAP – Sustainable Energy Action Plan
UNFCCC – United Nations Framework Convention on Climate Change
USAID – US Agency for International Development
VOC – Volatile Organic Compounds
Zn - Zinc
N(N)LE- (Non-entrepreneurial(non-commercial) legal entity)
Gg - Gigagram (10^9g= 10^3t)
GWP – Global Warming Potential
FIZ- Free Industrial Zone
MW - Megawatt (10^6 watts)
MDF – Municipal Development Fund
MSW - Municipal Solid Waste
HSW – Household Solid Waste
GDP – Gross Domestic Product
MJ - Megajoule (10^6 Joule)
RDF – Regional Development Fund
TJ- Terajoule (10^{12} Joule)
LLC – Limited Liability Company

INTRODUCTION – THE COVENANT OF MAYORS AND BATUMI CITY

In October 2010 the Georgian Government held a conference dedicated to the Covenant of Mayors. It highlighted the importance of cities as complex systems for the mitigation of emissions of greenhouse gases. The "municipality" was identified as a key player in developing and carrying out the country's Sustainable Energy Action Plans (SEAPs) to prioritize energy efficiency as defined by the European Union.
In 2011 Batumi joined this initiative by signing the Covenant of Mayors, which aims at a 20% mitigation of greenhouse gas emissions by 2020 – a goal which should be achieved along with the social and economic development of the city. To achieve this the Batumi City Hall created their Sustainable Energy Action Plan using materials from the simplified action plan prepared by a UNDP/GEF project "Third National Communication to the UN Framework Convention on Climate Change" (hereinafter called the Third National Communication), and the Economic Development Strategy of Batumi city. This SEAP was submitted to the Covenant of Mayor's Secretariat in March 2014. After submission, with support from the USAID funded "Enhancing Capacities for Low Emission Development Strategy (EC-LEDS) Clean Energy Program" this SEAP has been refined and improved. Major changes were made to buildings and transport chapters, for which the base year emission inventory and BAU projections have been improved, based on new data and mitigation measures that were redefined.

The Batumi Sustainable Energy Action Plan comprises:

- A greenhouse gases emissions inventory in the sectors of transport, buildings, street lights, waste and greening;
- A Business As Usual scenario for the emissions of greenhouse gases for these same sectors;
- A description of the measures for mitigating emissions of greenhouse gases in these sectors and reducing them by 2020;
- A monitoring plan;
- A local capacity building and awareness strategy

Batumi's economic rate growth, population trends and GDP growth per capita provided baseline data for the BAU scenario and for planning activities to reduce energy consumption in the city and mitigation of $CO_2$by 2020. Implementing the activities provided in this plan will ensure that at least 28% of greenhouse gas emissions are mitigated in the sectors discussed for Batumi by 2020, compared to the BAU scenario.

BATUMI CITY – BRIEF OVERVIEW

Batumi is the administrative centre of the Autonomous Republic of Ajara, and is a self governing city since 2006. At 368 kilometers from Tbilisi, Batumi is located on the Black Sea coast, and its crescent shaped territory covers 6494,31 hectares. It is located 2-5 meters above sea level in the Kakhaberi lowlands, and measures seven kilometers from northeast to southwest. Most of the city borders on the southern Bay of Batumi. Its northeast area borders along the Bartskhana and Korolistskali Rivers.

Georgia's role as transport corridor significantly increased after Perestroika, beginning in the 1990s when it increased economic relations with Europe and Asia. Along with the development of close economic relations with neighboring countries in the Caucasus, and a deepening regional cooperation, the role and function of Batumi as a sea gate for Georgia has developed naturally.


Today Batumi is a transport node for Georgia with large marine transport operations, and as the last point of the Baku – Batumi railway and pipeline. It is the oldest and most important port of transit for oil in the Caucasus and is equipped with modern equipment and services for ocean tankers.
Cargo for the city and its surroundings make up a significant share of total freight turnover. Loading/unloading processes for dry freight are fully mechanized and by 2012 had increased by 78% since 2000. [1]. A new marine station was constructed. Passenger transportation includes modern highways between Batumi and other important regions of Georgia as well as with Turkey. An international airport opened in 2007, which serves the whole region. One of the two border points with Turkey Batumi/Sarpi, is located 18 kilometers from Batumi, where freight is transported to and from other regions of Georgia, as well as for Azerbaijan and Armenia.


Batumi is becoming one of the most popular tourism locations in Georgia and internationally, with increased numbers of tourists from Europe and America. The highest figure was 400,000 recorded in 2009. Modern hotels such as Sheraton, Radisson and others, as well as entertainment centers are being built, with a dolphinarium opened in 2010. In 2009 the central promenade, the Boulevard of Batumi, was extended 1.5 kilometers and now stretches more than seven kilometers.
Batumi's climate is humid subtropical with warm, mild winters and hot summers. According to meteorological service of Batumi airport, the average annual temperature in the area is 14.3°C (1947-1960). The average temperature of the coldest month (January) is 6.50°C, and the hottest one (August) averages 22.6°C. An absolute minimum temperatures was registered as -9°C and absolute maximum +40°C. The average annual humidity is 75% and heavy showers are frequent.

[1] Source – Batumi port official website: www.batumiport.com

Error! Reference source not found. shows the population fluxuations from 1926 to 2012. Although total population increased until 1989 it then decreased until 2004 due to sociopolitical and economic events when there was increased migration to other countries and to the capital. A strong increase of the Batumi city population in recent years can be explained by improved social and economic conditions but also by the extension of Batumi's city territory as they incorporated more land. The boundaries of Batumi and Khelvachauri municipalities were changed and four territorial units were added to Batumi. On 1 January 2013, the Batumi numbered 170,000 persons.

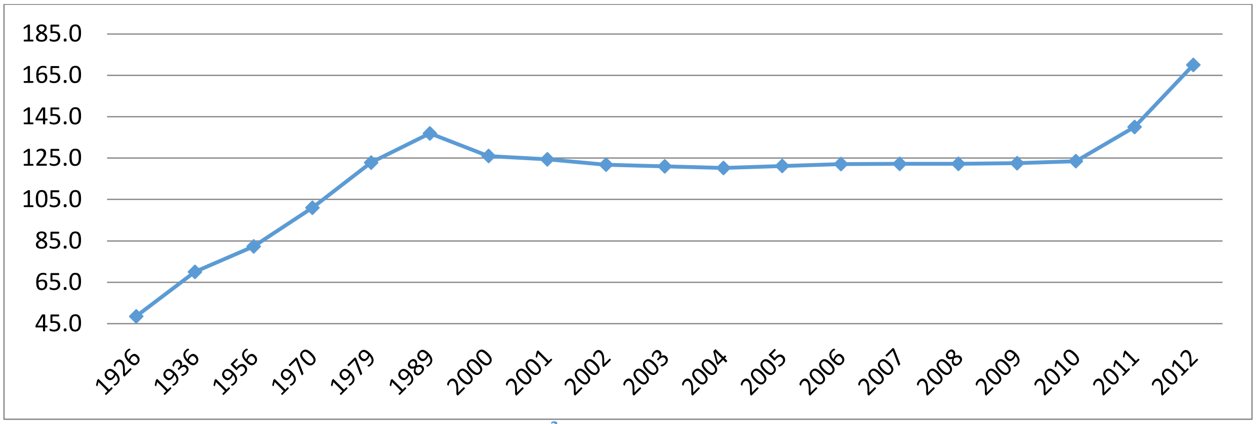

Figure 1. Batumi population size (thousands)[2]

The population is relatively young, with 24% under 18 years of age and a working age population of 63%. Retired persons make up 13%.

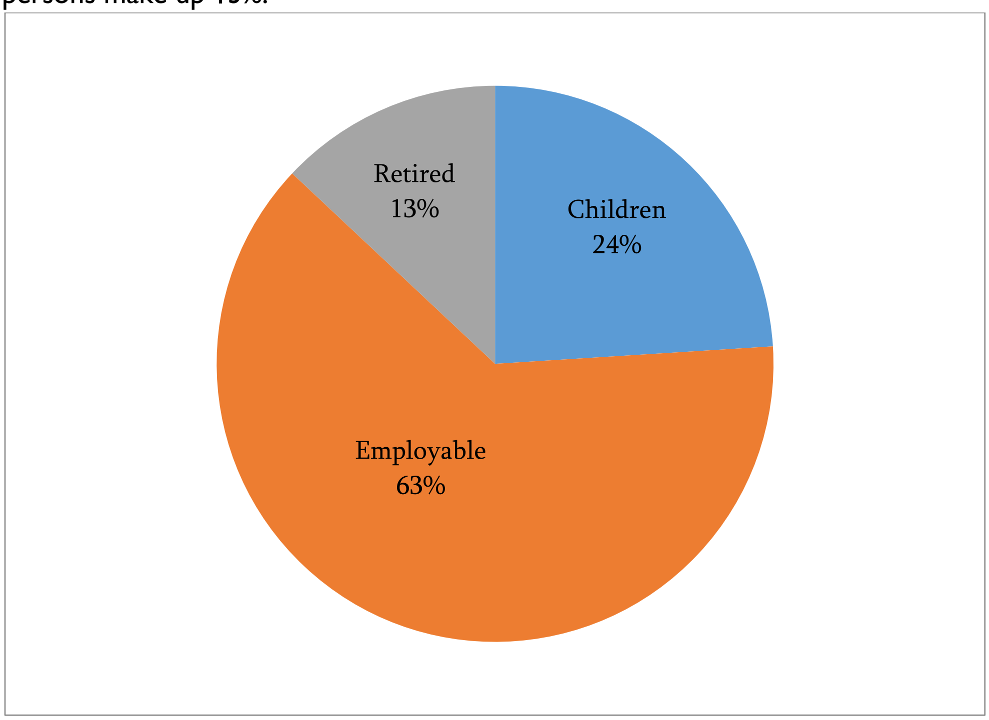

Figure 2. Structure of the population of Batumi city according to Population Census 2002.

[2] *Source – Batumi City Hall*

No statistical data are available on employment however based on Ajara's general data trends show a positive dynamic and increase of economically active and employed persons.

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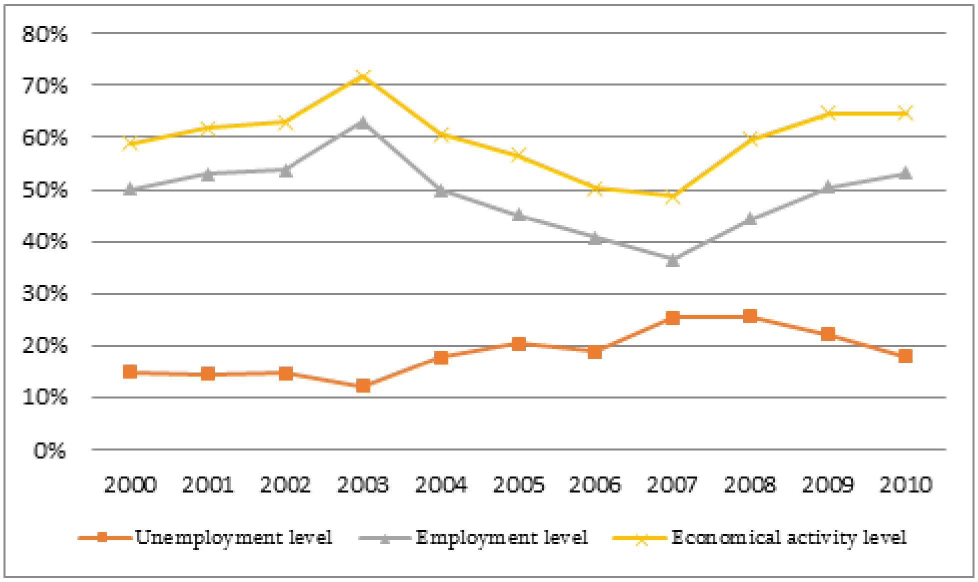


Figure 3. Employment rates in Ajara 2000-2010

Error! Reference source not found. presents the increase in gross added value in the region up to 2012 and the same indicator for Batumi up to 2010. Since no important changes took place in the region in 2011 – 2012, we can assume that the growing trend of added value of Batumi was identical during that period. Thus the indicator of gross value added and GDP levels respectively, exceeded respective indicators of 2006 by almost two times.

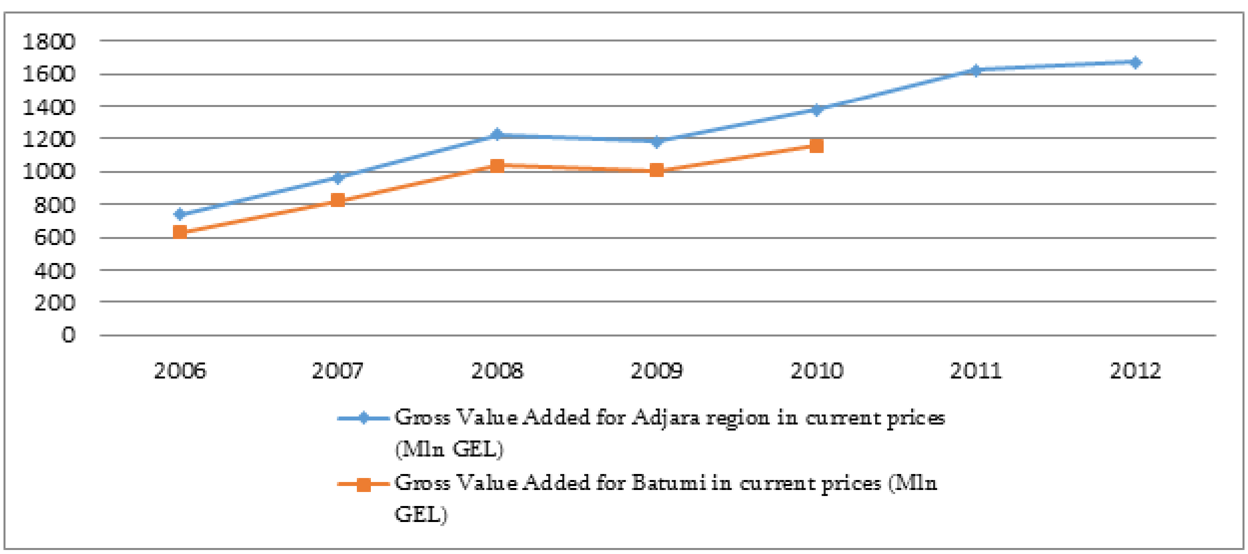


Figure 4. Gross Value Added of Ajara and whole region

In 2010 "Other services" had the biggest share in the structure of GDP produced in the city of Batumi, of which the main portion is tourism at 19%; public services and governance 17% and trade at 12%.

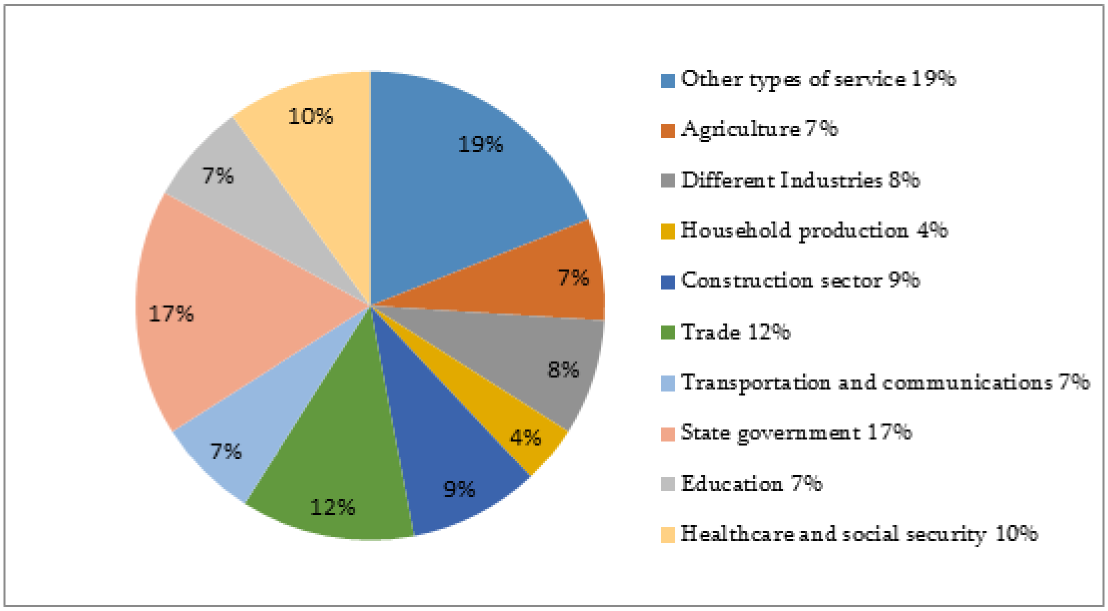


Figure 5. GDP of Batumi city by sectors 2010

During this time Batumi's city budget increased significantly compared to previous years (see **Error! Reference source not found.**), and helped transform the city into an important city in the Black Sea region.

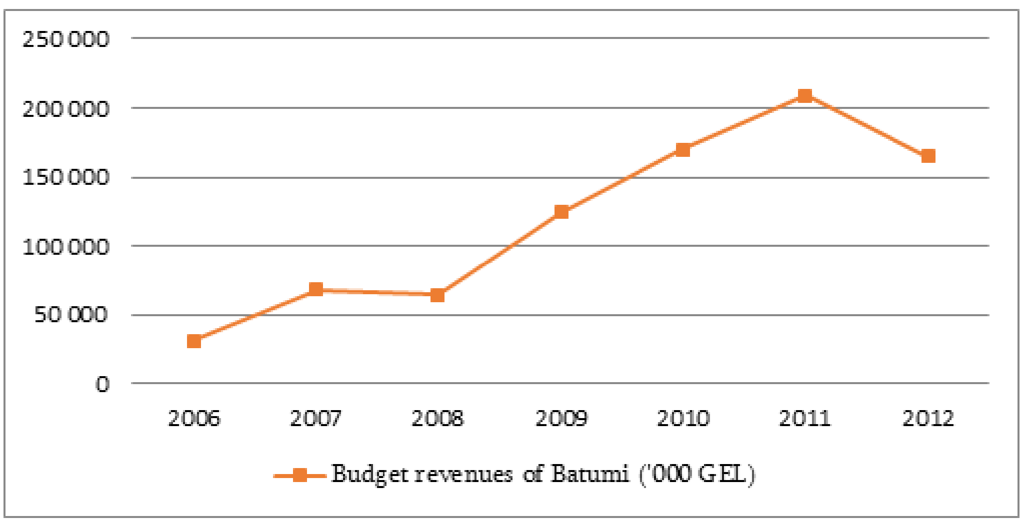


Figure 6. Revenues for Batumi city budget

Most financial resources are directed to the development of tourism, to transport and utilities infrastructure, to economic activities, culture and sport-- as well as to the protection of the environment. The percentages of the budget of Batumi city for 2012 is presented in **Error! Reference source not found.** and **Error! Reference source not found.** describes the annual dynamics. A large portion of the budget is reserved for activities found within the Sustainable Energy Action Plan, which will significantly simplify the task of implementing it successfully.

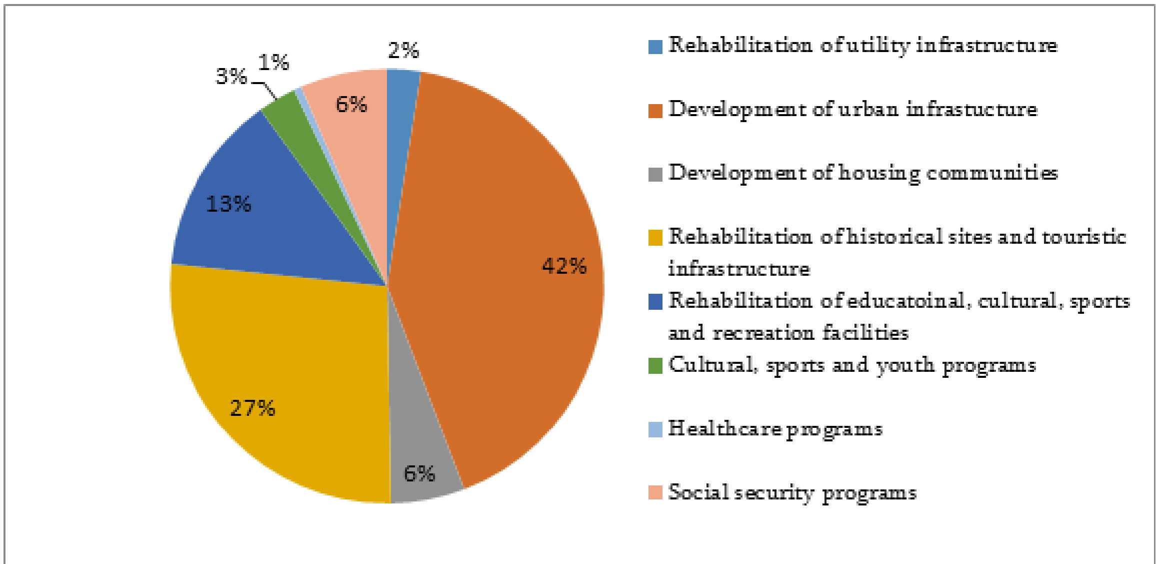


Figure 7.Distribution of the budget of Batumi city for 2012, in program profile 2012[3]

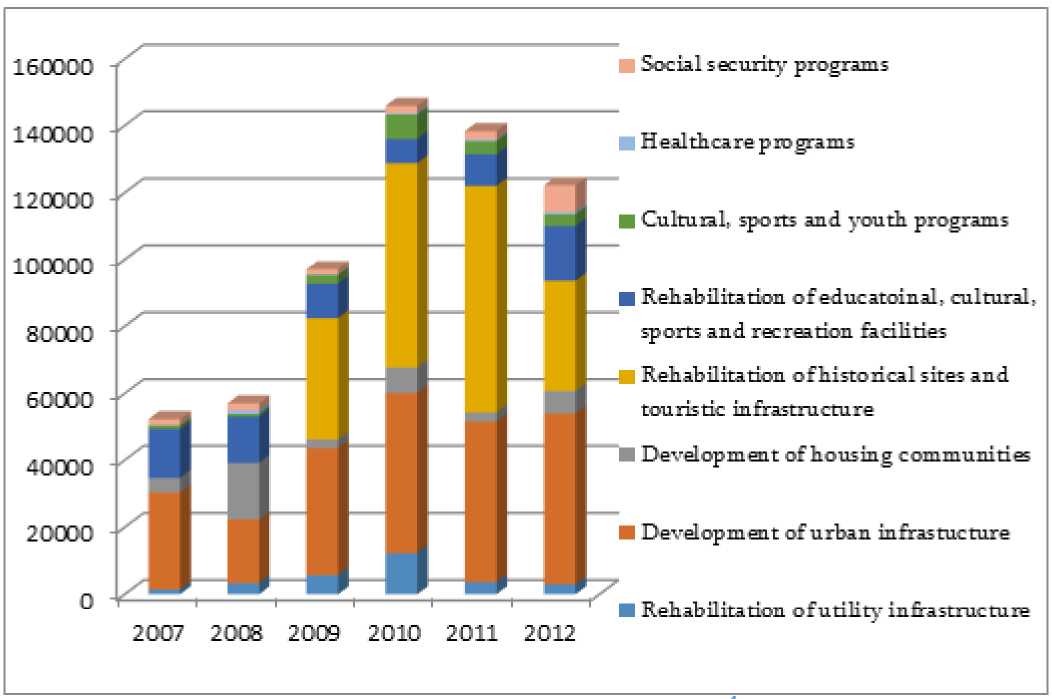


Figure 8. Distribution of the budget of Tbilisi city by years (thousand GEL)[4]

[3] *Source: Economic policy service of Batumi city hall*
[4] *Source: Economic policy service of Batumi city hall*

SUSTAINABLE ENERGY DEVELOPMENT STRATEGY

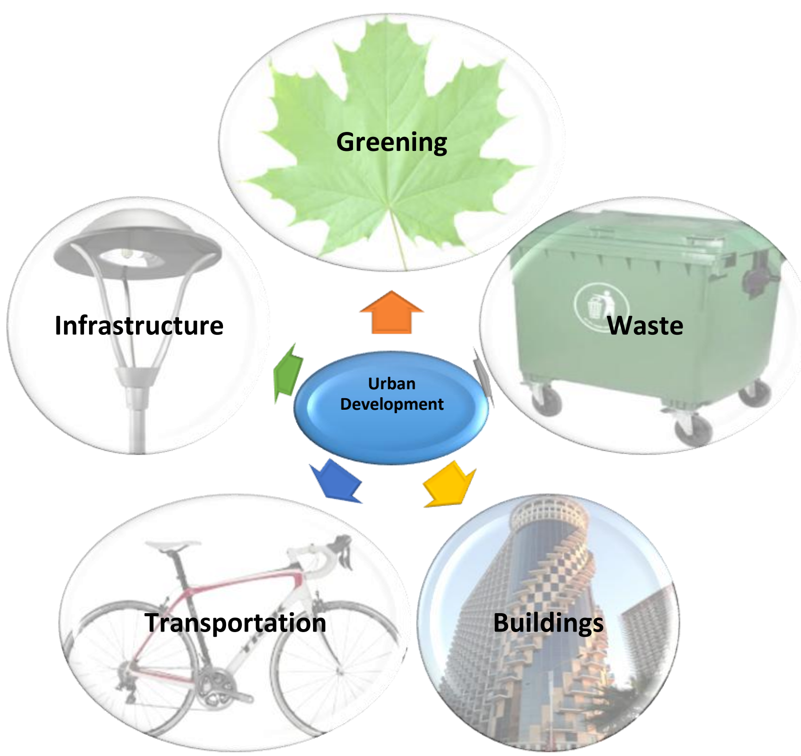
Although it is not the largest city of Georgia, Batumi is experiencing rapid economic growth with ambitious infrastructure projects and measures for tourism development. Although it was an impoverished corner of the former Soviet Union several decades ago, today it is a flourishing resort, with a vibrant night life. Despite significant achievements, however, Batumi still faces many problems-- low salaries, poor housing and buildings, as well as infrastructure facilities in disrepair.

In order to foster the economy of the region and solve its social and environmental problems, Batumi has set goals to grow and prosper as a sustainable city. In Batumi people care about the environment and their future and by creating the Sustainable Energy Action Plan (SEAP) these goals can be achieved. The main ones are:

- Improve living conditions in Batumi for all, and the conditions for developing tourism.
- Promote the development of tourism and economy.
- Improve the local environment to contribute to the solution of local and global environmental problems.

Sustainability is important-- to ensure that the social, environmental and economic systems that make up our community are providing a healthy and meaningful life for both residents and visitors. Since urban development is a priority for Batumi, and affects the population and tourists alike, the SEAP was developed to mitigate these impacts.

By taking into account the principles of sustainable urban development, the main sources of greenhouse gas emissions in Batumi are identified—in the sectors of buildings, transportation, waste and infrastructure, emission mitigation and greening. Planned and implemented urban planning will have a long-term impact on the sustainability of the city.



Strategy for mitigating emissions of greenhouse gasses (GHG) from the transportation sector

Urban Development

Transportation

1. Promote active movement. This includes bicycle and pedestrian transportation that promote both the environment and health. Giving priority to pedestrians and cyclists in urban planning will also increase the attractiveness of the city.
    - Promote awareness of residents and tourists on the possibilities for walking and biking, and as healthy lifestyles. (short-term strategy).
    - Create biking trails and tourist routes, and ensure the development bicycle hire for tourists (short-term strategy).
    - Create walking and pedestrian streets (long-term strategy).
2. Decrease the necessity of traffic movement. For residents the necessity to travel is often because residential districts are separated from commercial, administrative and school districts. A mixed type of urban planning will significantly reduce the necessity of movement, for example:
    - Design districts of mixed use where commercial, entertainment and other types of services are accessible where appropriate (short-term strategy).
    - Promote technical possibilities for online access to services via internet. This includes tourism information, state services, notifications/news, taxation services etc. (short-term strategy).
3. Set limits on vehicle emissions. Private cars represent one of the largest sources of emissions in Batumi and despite the fact that they are important for transportation they deteriorate the quality of life and pollute the atmosphere. Decreasing the use of the private cars has many positive effects, such as decreasing financial expenditures by residents and tourists, decreasing noise, improving air pollution indicators, and mitigating GHG emissions. Main activities planned:
    - Improve the public transportation infrastructures such as access other types like tramway, electric taxi, funicular or cable car etc., while planning of public transport routes and stops so it is available from all parts of the city. (long-term category).
    - Promote public transportation, including information to the population and promotional events (short-term strategy).
    - Change to energy efficient technologies. At the first stage use natural gas for private as well as municipal transport (short-term strategy), and then use electric transportation (long-term strategy). Special attention should be paid to the development of electric transportation (tramway, electric taxi, and cable-car. In the future the electricity grid emissions factor will be substantially mitigated in Georgia as the central government plans to increase hydro power stations.
    - Organize centralized parking areas at the entrance of the city, to allow tourists to leave their cars in safe zones and use public transportation (long-term strategy).

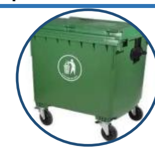
Strategy for mitigation of GHG emissions in the buildings sector	Urban Development	Buildings

1. Increase energy efficiency in municipal and residential buildings. Energy efficiency often means changing the style of construction including design and building materials. This can be carried out at relatively low cost when carried out in the early stages of design and planning. Main activities planned:
    - Add energy efficiency criteria to New House, the new project of Batumi City to offer cheap housing to the population, at their basic cost. The energy efficiency criteria will be added to the existing construction criteria for these houses.
    - In municipal buildings where construction work is planned (kindergartens, new municipality buildings), improving insulation will be added to standard construction work.
    - Promote energy efficient lighting in residential and municipal buildings.
    - Mitigate the urban “heat island” effect by selecting building designs and reflective colors during urban planning to improve natural ventilation.
    - Elaborate new construction norms ensuring the use of energy efficiency measures in the new buildings (long-term strategy).
2. Increase energy efficiency in the commercial sectors. Including the commercial sector is one of the prerequisites for achieving energy sustainability in Batumi and implies cooperation with the private sector. Awareness raising campaigns, as well as technological exhibitions and seminars will be organized. Special attention will be paid to raising energy efficiency in constructions for tourists as tourism is a strategic direction for the development of Batumi’s economy.

Strategy of the mitigation of greenhouse gasses from the infrastructure sector considers:	Urban Development	Infrastructure

1. Renovate Batumi’s outdoor lighting system according to modern standards, including:
    - Design an audit system for Batumi outdoor lighting
    - Equip outdoor light poles with modern energy-efficient bulbs.
    - Establish a computerized lighting system with central control.
    - Introduce management and monitoring software.
    - Eliminate energy loss in the external lighting system.

Strategy of mitigation of methane from the waste sector includes:	Urban Development	Waste



1. Install a methane gas extraction system on the old landfill of Batumi and a wastewater treatment plant for electricity generation. The old landfill and the wastewater treatment plant are located so close to each other that it is possible to collect methane generated in both places and use it for electricity for highway lighting in the vicinity.
2. Install methane gas extraction and flaring, or use on-site systems at Kobuleti's new landfill.

Batumi's Greening Strategy	Urban Development	Greening

1. Plan Batumi's greening within the urban development plan to be designed and implemented aiming at annual increases of urban greening and green cover.

Summary of Batumi's Sustainable Energy Action Plan

The Batumi SEAP development methodology does not use a fixed baseline year, which would pose considerable risks to urban development, making it almost impossible to comply with the commitments. The applied method envisages a development prospect for Batumi, as well as an inevitable growth of emissions (as a result of increased demand for energy carriers) by 2020. This growth is considered under the Business As Usual (BAU) scenario, against which the emissions are reduced by implementing activities and projects. The details of the BAU scenario development methodology are provided in the Transport chapter.

A summary of Batumi's 2012-2020 inventory results and assessment of emissions saved as a result of implementation of the SEAP measures are:

Table 1. GHG Emissions in Batumi in 2012 and 2020 (tons CO2 eq.)

Sector	2012	2020 (BAU)
Transport	74 193	97 497
Buildings	87 782	124 948
Street Lighting	1 959	2 222
Waste	37 653	72 597
Total	**201 588**	**297 263**

Table 2. Emissions savings in different sectors according to Batumi SEAP

Sector	Saving (tons CO2eq.)
Transport	12 673
Buildings	20348
Street Lighting	1 215
Waste	49 067
Landscaping	680
Total	**83 982**

Fig. 9 shows emission distribution by sectors under the Business As Usual (BAU) scenario in the baseline years of 2012 and 2020. Whereas Figures 10-13 show emission growth in different sectors for the BAU and Sustainable Energy Action Plan (SEAP) scenarios.

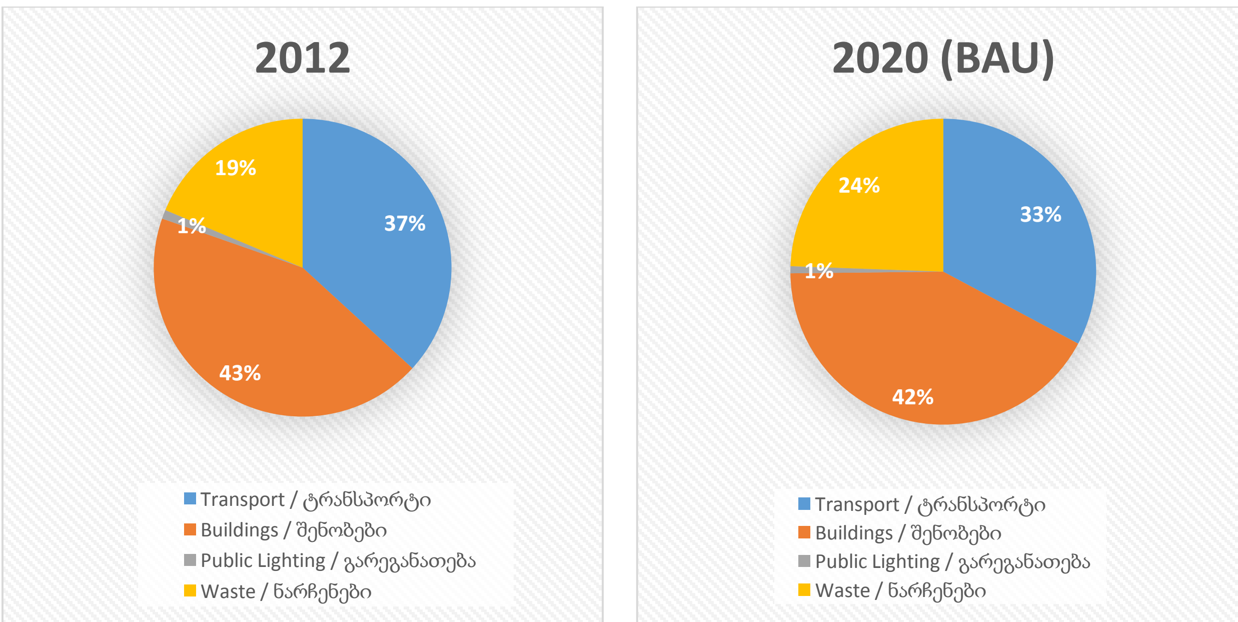


Figure 9. Emission distribution by sectors in the years 2012 and 2020.

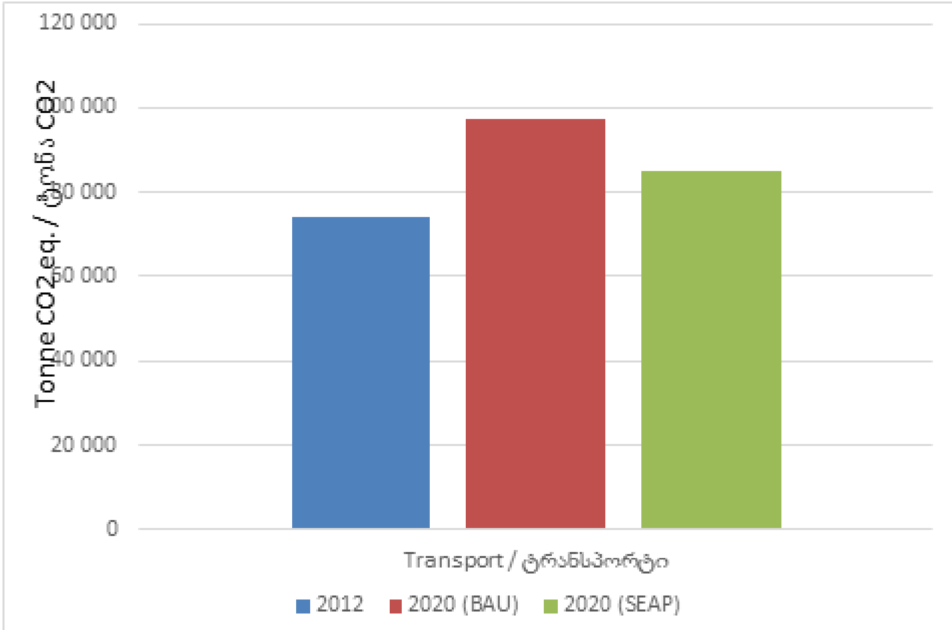


Figure 10. Increase in emissions according to the BAU and Sustainable Energy Action Plan (SEAP) scenarios in transport sector

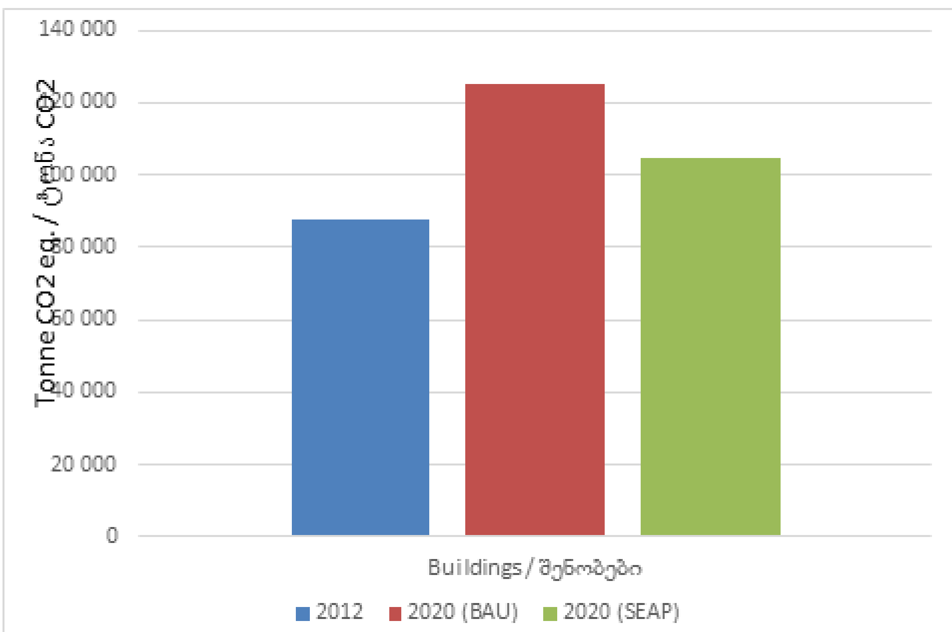


Figure 11. Increase in emissions according to the BAU and the Sustainable Energy Action Plan (SEAP) scenarios in buildings sector.

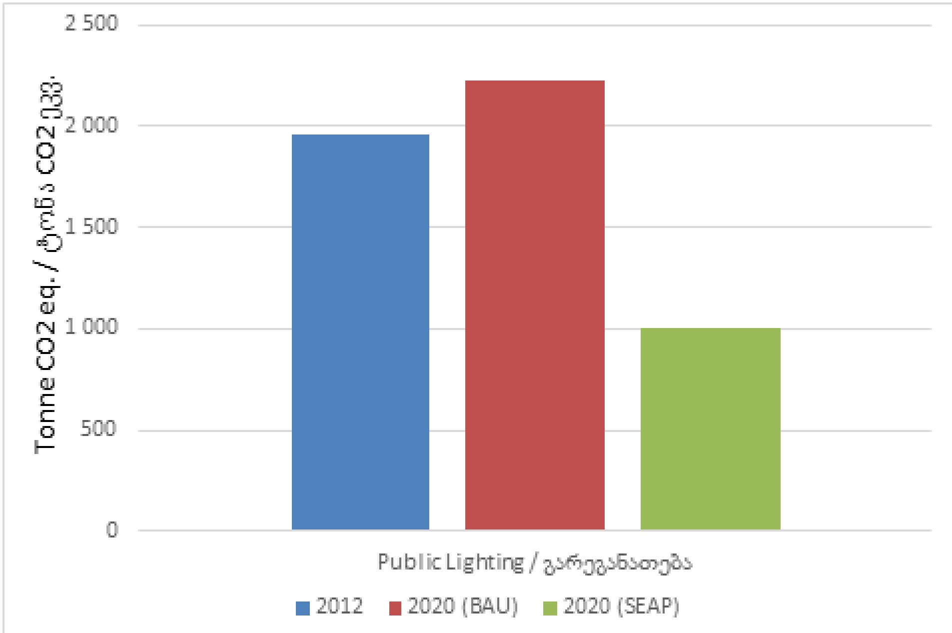


Figure 12. Increase in emissions according to the BAU and the Sustainable Energy Action Plan (SEAP) scenarios in street lighting sector.

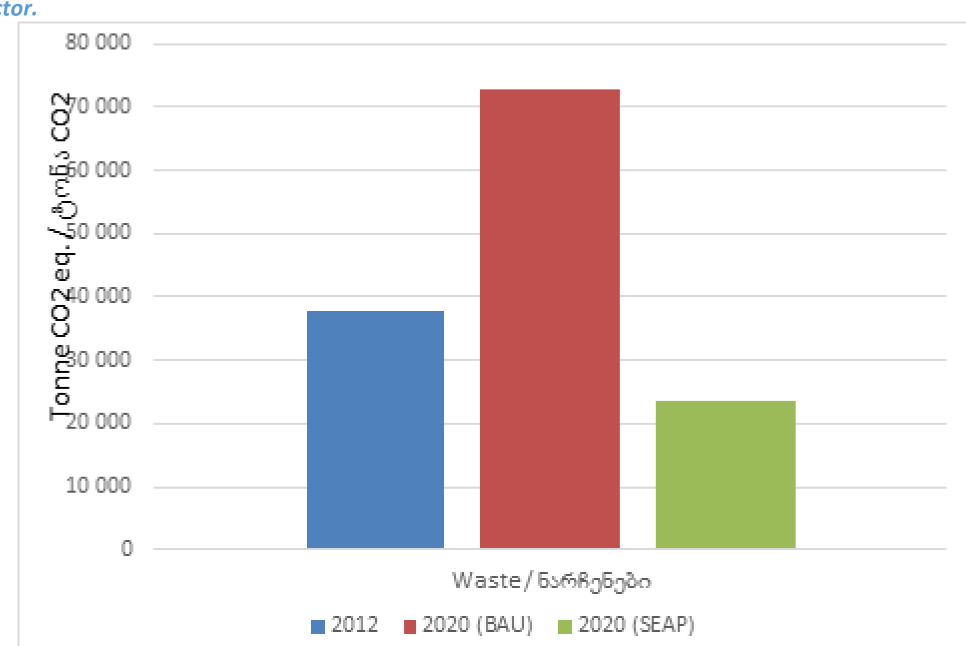


Figure 13. Increase in emissions according to the BAU and the Sustainable Energy Action Plan (SEAP) scenarios in waste sector.

TRANSPORT
Sector Overview

Batumi is one of the most densely populated and fastest growing cities in Georgia. According to the Department of Statistics, its population was recorded as 121,000 in 2003, 140,000 in 2010 and 170,000 in 2012 (partially due to adjunction of new territories near Batumi). Based on regional allocation principles, the city is divided into 13 territorial units/districts: Old Batumi; Rustaveli, Bagrationi, Aghmashenebeli, Javakhishvili, Tamari, Khimshiashvili, Boni-Gorodok, Airport; four other territorial units/districts were added in 2011: Kakhaberi, Batumi Industrial, Gonio-Kvariati and Green-Cape.

The dynamic development of the city and proximity to other populous towns has meant that the city limits have changed twice: Up to 2009 the city's territory was 19.5 km2. In 2009-2011 it was 25 km2 and as of 2011 it is 64.94 km2.

The street plan was created in the second half of the 19th century. The road network formed as a rectangular grid in accordance with the functional differentiation of the streets. The longitudinal axis of the streets leads to the sea and are mostly oriented North - West - South - East and South - West - North - East direction. Rectangular grid step tend to change close to the oldest part of the city near the port. Network of the streets becomes denser. There are open culverts, or drainage channels along the streets. The vertical orientation of Batumi slopes gently and the transverse profile of the streets is quite well-designed. Their width is between 20-25 meters in places and the city was designed with the main attention paid to sea-front development. Streets are wide and comply with transport requirements and aesthetic considerations, which ensure Batumi's attractiveness and the unique character of the city.

One of the distinguishing features of the city is that it was constructed according to Roman design, divided into squares by parallel streets (pic.12). This significantly facilitates traffic.

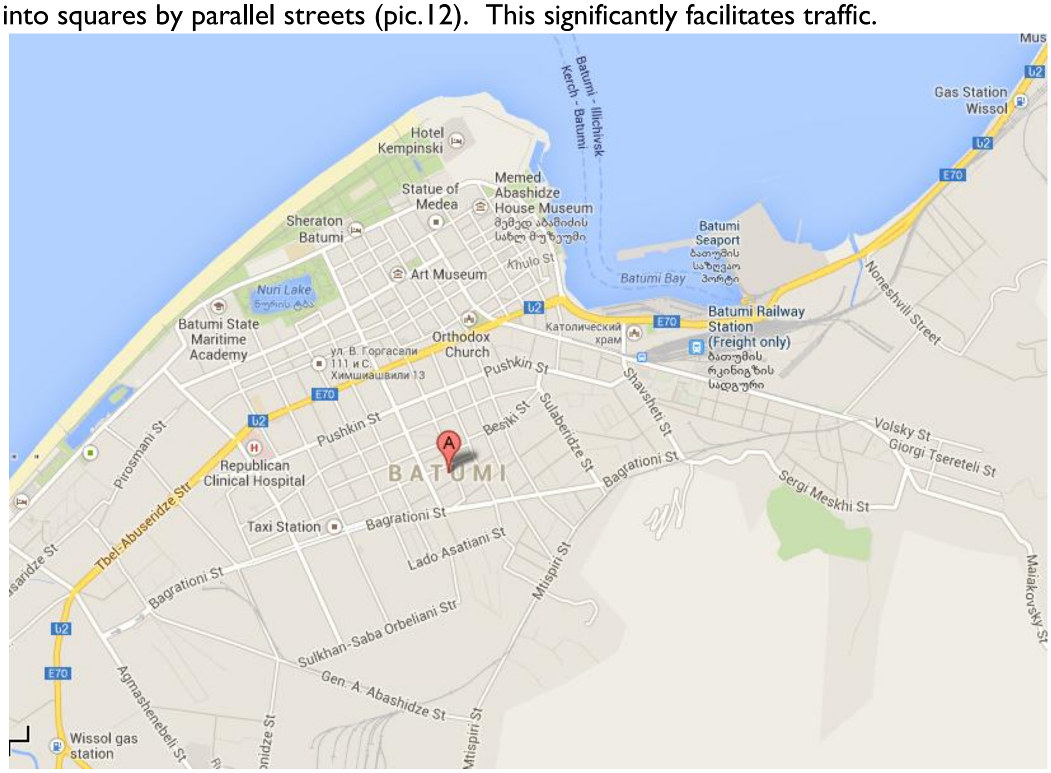


Figure 14. Batumi streets structure

An increase in the city's population has led to a significant traffic glut and is causing a rise of CO_2 emissions as well as congestion, loss of greenery, air pollution and excessive noise. In 2011 GHG emissions in Ajara reached 276.4 thousand tons in CO_2 of which 53% was caused by the transport sector and most (86%) originated from Batumi.

Developing the transportation sector is closely linked to the growth of the city itself and to the internal movement of the population. According to data from 2012, the average number of vehicles on the territory of Ajara was 650,000 of which most were in Batumi. As a tourist city Batumi has a high demand for transport services during tourist seasons.

Table 3 shows the numbers of registered vehicles by fuel types in Batumi in 2009-2012.

Table 3. Registered vehicles in Batumi (cars)

Vehicles	**Cars (except for taxi and municipal transport)**				**Transport of Batumi municipality**			
Fuel Type	**2009**	**2010**	**2011**	**2012**	**2009**	**2010**	**2011**	**2012**
Gasoline	15 400	16 355	18 200	19 250	40	45	60	78
Diesel	1 500	1 700	2 100	2 800	4	3	2	15
Natural gas	68	102	356	1 450	0	0	0	0
Total	**16 969**	**18 160**	**20 665**	**23 525**	**44**	**48**	**62**	**93**

Table 4. Vehicles registered in Batumi (public transport)

Vehicles	Taxi				Buses				Minibuses			
Fuel Type	**2009**	**2010**	**2011**	**2012**	**2009**	**2010**	**2011**	**2012**	**2009**	**2010**	**2011**	**2012**
Gasoline	368	458	360	650	43	52	52	65	120	118	85	110
Diesel	210	260	420	510	250	256	350	350	800	1 100	1 568	1 600
Natural gas	5	4	17	100	0	0	0	12	11	5	3	15
Total	**545**	**722**	**797**	**1 285**	**293**	**308**	**402**	**427**	**931**	**1 223**	**1 656**	**1 725**

Only vehicles driving inside the city on internal roads were counted. Other vehicles either work on inter-city routes, or are dis-used. The number of buses and mini-buses operational on routes within the city are shown in the next tables.

Table 5. Vehicles for public transport inside the city

Vehicles	Buses	Mini-buses
Diesel	130	650

Table 6. Vehicles registered (commercial transport)

Vehicles	Light Commercial vehicles (up to 2 tons)				Heavy Trucks			
Fuel Type	**2009**	**2010**	**2011**	**2012**	**2009**	**2010**	**2011**	**2012**
Gasoline	15	12	25	50	2	3	0	0
Diesel	150	241	305	425	95	158	230	310
Total	**165**	**253**	**330**	**475**	**97**	**161**	**230**	**310**

Table 7 shows the efficiency and mileage of different types of transport, used for estimation of fuel consumption.

Table 7. Characteristics of Batumi transport

Vehicles	Cars (except for taxi and municipal transport)	Taxi	Transport of Batumi municipality	Buses	Minibuses	Light Commercial vehicles (up to 2 tons)	Heavy Trucks
Annual mileage (vehicle-km)	7 000	10 000	5 000	100 000	61 200	21 600	43 200
Gasoline efficiency (l/100 cm)	12	7.5	7.5	20	13,5	14	25
Diesel efficiency (l/100 cm)	12	7.5	7.5	23	13,5	14	25
CNG efficiency (l/100 cm)	7	6,5					

Mileage in Table 7 covers urban as well as non-urban travel, and in Table 8 segregated figures between urban and rural travel have been used.

Table 8. Distribution of urban and rural travel

vehicles	urban	rural	highway
Cars	70%	20%	10%
Light trucks	60%	20%	20%
Buses and mini-buses	100%	0%	0%
Heavy trucks	70%	15%	15%

Only urban travel was accounted for in the base year inventory.

Methodology

Like in other sectors, the year 2012 is the base year used for the transport sector. Greenhouse gas emissions were calculated by a formula based on the Intergovernmental Panel on Climate Change (IPCC)' methodology, level I sector approach, and adapted for the local level, which is based on actual fuel consumption data.

$$\text{Carbon Dioxide emission}_j(\text{Gg } CO_2) =$$
$$\square\square_i\{\text{Actual fuel consumption }_{ji}(\text{unit})$$
$$\times \text{ Fuel net calorific value}_i(\text{MW.h}^5\text{/per unit})$$
$$\times \text{ Carbon emission factor (tC/MW.h)/1000}$$
$$\times \text{ Oxidized carbon share }_i\}$$

[5]Terajoule is the basic energy unit in the IPCC methodology, whereas in the SEAP methodology MW.h is used. Therefore, MW.h is used in the present document.

$\times 44/12$,

Where lower index j refers to sector and lower index i refers to the type of fuel.

For other gases, emissions according to a sector approach have been calculated using the formula:

$$\text{Greenhouse gas emission}_j(\text{Gg Gas}) = \square\square_i\{[\text{Actual fuel consumption}_{ji}\ (\text{unit}) \times \text{Fuel net calorific value}_i\ (\text{MW.h/per unit}) \times \text{Gas emission factor}_{ji}\ (\text{tgas/MW.h})/1000].$$

When calculating the typical values of carbon emission factors (carbon emission per energy unit) and conversion coefficients (Net Calorific values) from 1996, IPCC guidelines were used.

Table 9. Conversion Coefficients and Carbon Emission Factors for Different Types of Fuel

Fuel Type	Unit	Converter (MW.h/unit)	Carbon Emission Factor (tC/MW.h)
Gasoline	1000 liters	0.01	0.247
Diesel Fuel	1000 tons	0.011	0.267
Liquid Gas	1000 tons	0.013	0.227
Natural Gas	1 mln. m^3	0.009	0.202
Firewood	1000 m^3	0.002	--

The 2012 grid average emission factor for electricity - 0.136 kg CO_2/kW.h. was applied.

A small portion of carbon in fuel is not oxidized during combustion, but most of this is later oxidized much later into the atmosphere. When calculating emissions this delayed oxidation is included. The IPCC-recommended typical values of oxidized carbon used in the 2006-2011 inventory are presented in Table 10.

Table 10. Share of Oxidized Carbon in Different Types of Fuel

Fuel	Oxidized Carbon Share
Oil and Oil Products	0.990
Natural Gas	0.995

Other gas emissions factors for the transport sector are shown in Table 11.

Table 11 .Methane and Nitrous Oxide Emission Factors for Transport Sector (kg/MW.h)

Greenhouse Gas	Gasoline	Diesel	Natural Gas
CH_4	0.072	0.018	0.18
N_2O	0.002	0.002	0.0004

The global-warming potential (GWP) values of GHG are used for converting methane and nitrous oxide into carbon dioxide equivalent.

Table 12. Methane and Nitrous Oxide Global-Warming Potential (GWP)

Gas	Lifetime, year	100-year GWP
CH_4	12±3	21
N_2O	120	310

The European Union's Joint Research Center (JRC) developed a Guidebook[6] for the Eastern Partnership member-state cities, under which these cities are given a choice to determine the mandatory reduction of emissions by following three alternative approaches:

1. Reductions against fixed base year absolute emissions
2. Per capita emissions reductions against fixed base year emissions
3. Reductions against the 2020 Business As Usual (BAU) scenario's projected emissions

The third alternative--emissions reduction calculations for the BAU scenario—was chosen for the Batumi SEAP. The guidelines describe two possible options to build a scenario:

1. The city can develop an individual methodology that will be further assessed by the JRC.
2. The city can use Georgian national coefficients developed under the Emission Database for Global Atmospheric Research (EDGAR) CIRCE[7] Project. The POLES (Prospective Outlook for the Long term Energy Systems)[8] method has been also applied. The latter considers energy consumption growth due to population and economic growth. On the basis of the baseline year, the BAU scenario calculates the emissions level for 2020 assuming that the current population, economy, technologies and human behavior trends will continue and no local or national emission reduction measures[9] will be taken.

For Batumi the first approach has been applied, i.e. an individual methodology has been developed, although it is similar to the second approach. Like the second approach, the national growth coefficients are used, but unlike this approach:

1. Coefficients have not been obtained from research conducted outside the country like JRC coefficients, but rather on the basis of the results of the BAU scenario, which is based on the MARKAL-Georgia model to elaborate Georgia's low-emissions development and energy development strategies. Consequently, these coefficients better reflect the country's current developments and future directions.
2. Coefficients are available not only at the total emissions level, but also at different sector levels, allowing better planning for mitigation measures.

[6]"HOW TO DEVELOP A SUSTAINABLE ENERGY ACTION PLAN (SEAP) IN THE EASTERN PARTNERSHIP AND CENTRAL ASIAN CITIES" – GUIDEBOOK, European Commission Joint Research Centre, Institute for Energy and Transport, Luxembourg: Publications Office of the European Union © European Union, 2013

[7]U.M. Doering, G. Janssens-Maenhout, J.A. van Aardenne, V. Pagliari (2010), CIRCE report D.3.3.1, Climate Change and Impact Research in the Mediterranean Environment: Scenarios of Future Climate Change IES report 62957.A. Pozzer, P. Zimmermann, U.M. Doering, J. van Aardenne, H. Tost, F. Dentener, G. Janssens- Maenhout, and J. Lelieveld, Effects of business-as-usual anthropogenic emissions on air quality, Atmos. Chem. Phys. Discuss., 12, 8617-8676, 2012, doi:10.5194/acpd-12-8617-2012

[8]Russ, P., Wiesenthal, T., van Regenmorter, D., Ciscar, J. C., 2007. Global Climate Policy Scenarios for 2030 and beyond. Analysis of Greenhouse Gas Emission Reduction Pathway Scenarios with the POLES and GEM-E3 models, JRC Reference report EUR 23032 EN. http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=1510

[9]JRC Report, "An approach with a Business-as-Usual scenario projection to 2020 for the Covenant of Mayors from the Eastern Partnership", 2012. http://edgar.jrc.ec.europa.eu/com/JRC-IES_CoM-East_report_BAUprojections2.pdf

3. If there are population and Gross Domestic Product (GDP) growth projections at the municipal level, they can be applied to modify the MARKAL-Georgia national coefficients.

The Muni-EIPMP (municipal emissions' inventory, projection and mitigation planning) is a simple, Excel-based software tool developed through this method under the USAID-funded "Enhancing Capacity for Low-Emission Development Strategies Clean Energy Program", on which the BAU scenario projections are based. It is adapted to each specific municipality inventory. Applied coefficients are shown in the table below (Table 16).

In addition to greenhouse gases for the Batumi transport sector, other transport-emitted local pollutants have been also evaluated. The European Environment Agency (EEA) developed the COPERT IV (Computer Programme to Calculate Emissions from Road Transport) software that is widely applied in Europe, and has been used for this purpose. Data available in different regions of Georgia need to be adapted to the COPERT IV model, since a substantial part of it does not exist--by using standard values of properly selected initial data; COPERT IV allows approximate evaluation of emissions. However, due to a lack of vehicle technical inspection and fuel quality data, the true values of pollutant emissions are likely to be much higher than those provided here.

The numbers of vehicles and consumed fuel data have been tailored to specific locations. Applying COPERT allows the database to be regulated and creates a precondition for full-fledged use of this software to calculate transport sector emissions. Naturally, a system for collecting certain categories of data should be developed. These results, so far, were applied only to show emission trends in order to determine which are more likely to grow or to decline as a result of measures taken.

The following pollutants have been additionally evaluated using COPERT:

- Heavy metals: Lead (Pb), Cadmium (Cd), Copper (Cu), Chromium (Cr), Nickel (Ni), Selenium (Se), Zinc (Zn);
- Volatile: Volatile Organic Compounds (VOC), Non-Methane Volatile Organic Compounds (NMVOC);
- Non-Volatile: Carbon Monoxide (CO), Nitrogen Oxides (NOX, NO, NO2, NH3), Particulate Matters (PM);

Direct greenhouse gas emissions (C02, N2O and CH4) for all transport vehicles registered in Batumi have been evaluated and compared to the inventory results.

Base Year Inventory and Greenhouse Gas Emissions Baseline Scenario (2013-2020)

Batumi's transport sector structure and the base year inventory use 2012 data and cover the following types of transport:

- Municipal service vehicles
- Public transport (buses, mini-buses and taxis)
- Private and commercial transport

According to the Sustainable Energy Action Plan development methodology, fuel consumption by navigation, air and railway transport is not considered, since these types of transport do not take place within the city's territorial limits. In 2012, the fuel consumption of Batumi's transport sector totaled 291,000 MW.h.

Table 13. Batumi Transport Sector's Final Energy Consumption (MW.h) – 2012

Subsector	Natural Gas	Diesel	Gasoline	Total
Municipal Vehicle Fleet	0	90	332	422
Public Transport	2 123	83 637	16 211	101 971
Private & Commercial Transport	6 393	42 909	139 552	188 854
Total	**8 516**	**126 636**	**156 095**	**291 247**

In 2012, the greenhouse gas emission from the transport sector made approximately 74.2 thousand ton CO_2 –equivalent.

Table 14. Batumi Transport Sector's Greenhouse Gas Emission in CO_2 Equivalent (Ton) – 2012

Subsector	Natural Gas	Diesel	Gasoline	Total
Municipal Vehicle Fleet	0	24	83	107
Public Transport	435	22 164	4 039	26 638
Private & Commercial Transport	1 309	11 371	34 769	47 449
Total	**1 744**	**33 559**	**38 891**	**74 193**

Other local pollutant emissions in 2010-2013 are given in the following table, which shows the emissions by transport registered in Batumi both inside and outside the city.

Table 15. Total Pollutant Data and Percentage Difference between 2010 – 2013

№	Name	Measurement Unit	Year					2009 - 2013 Difference
			2009	2010	2011	2012	2013	
1	PB	t	12.27	0.01	0.01	0.01	0.02	**22%**
2	Caidum	t	0.3300	0.0004	0.0004	0.0004	0.0004	**20%**
3	Copper	t	147.75	0.16	0.16	0.17	0.19	**21%**
4	Chromium	t	5.97	0.01	0.01	0.01	0.01	**21%**
5	Nickel	t	2.630	0.003	0.003	0.003	0.003	**19%**
6	Selenium	t	0.0003	0.0004	0.0004	0.0004	0.0005	**18%**
7	Zinc	t	0.058	0.06	0.06	0.07	0.08	**22%**
8	VOC	t	743.52	794.74	846.38	894.09	961.01	**21%**
9	NMVOC	t	715.41	764.88	814.99	860.27	922.81	**21%**
10	CO	t	5 802.51	6 271.96	6 828.76	7 235.20	7 710.28	**23%**
11	CH4	t	28.08	29.86	31.29	33.77	38.14	**28%**
12	NOX	t	821.42	864.61	852.86	910.57	1 009.66	**17%**
1	NO	t	754.78	795.05	786.81	842.68	929.93	**17%**

3								
14	NO2	t	66.64	69.56	66.04	70.90	79.69	**15%**
15	N2O	t	2.70	2.85	2.84	3.03	3.31	**16%**
16	NH3	t	0.48	0.53	0.61	0.81	0.96	**81%**
17	PM	t	39.09	40.68	38.19	41.77	46.63	**15%**

According to the MARKAL-Georgia model, the transport sector's greenhouse gas emissions growth rates are as follows:

Table 16. Fuel Consumption Growth Rates for Different Types of Transport under the BAU Scenario

Sector	2012	2013	2014	2015	2016	2017	2018	2019	2020
Transport	1	1.05	1.10	1.1	1.19	1.23	1.3	1.29	1.31

Due to a lack of projections for Batumi's population or GDP growth, the national projections have been used without modification. Under the growth baseline scenario, the transport sector's greenhouse gas emissions for 2020 amount to 94,300,000 thousand tons of CO_2 equivalent.
Increases in greenhouse gas emissions in the transport sector are shown in Fig 15:

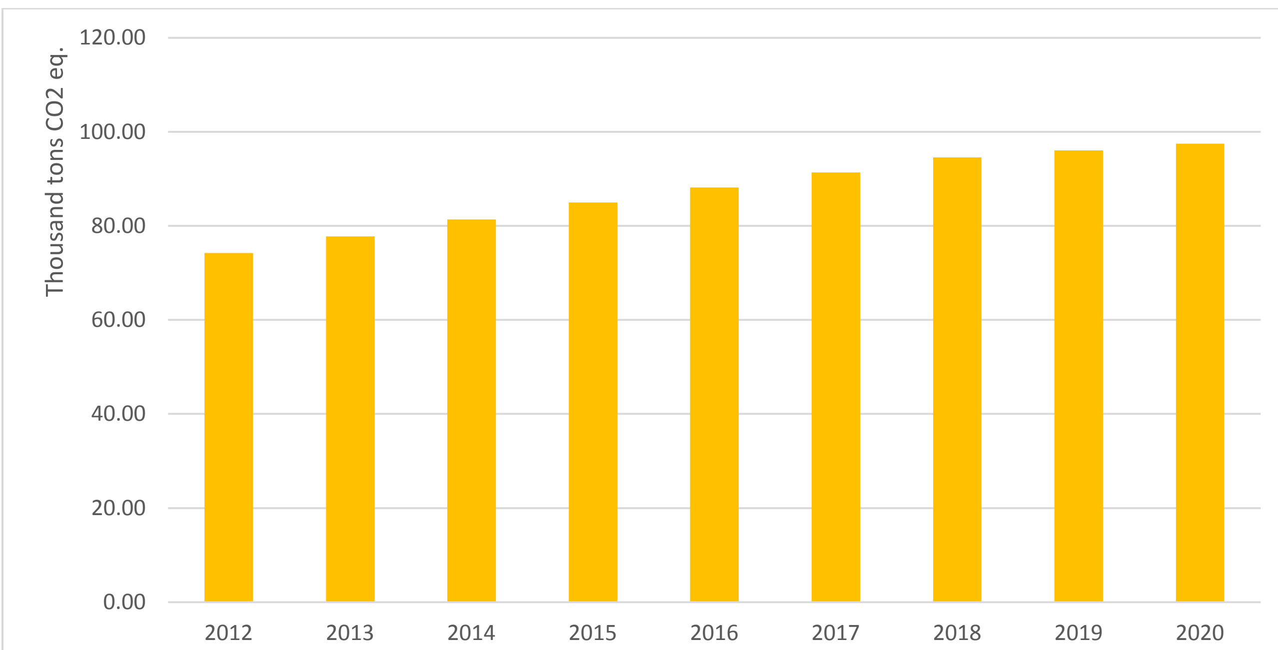


Figure 15. Trend of Transport Sector Emissions under the BAU Scenario

Batumi Transport Sector Emissions Reduction Action Plan

Global environmental, social and economic challenges mean that a shift must be made to public transport, walking and cycling, electric or other more sustainable means of travel. Different countries have different starting points for tackling this problem. For instance, in highly developed countries, it has become necessary to overcome a dependency on private car use, and to shift from urban areas with low-density segmented planning to mixed types of planning schemes. In developing countries, the rates of public transportation use and population density are relatively high and land planning is more mixed, which is the best starting point for sustainable development of this sector. Regrettably, other problems are inherent in the transport sector of developing countries such as traffic congestion, air pollution and poor quality of transport infrastructure and services. Therefore, these problems are priorities in developing countries. Even though the numbers of vehicles is not as acute a problem as in developed countries, today rapid economic growth in many countries of the developing world is causing an increase in the number of private vehicles and posing a threat to their future, which means appropriate measures must be taken. Traffic congestion, noise, road safety, air pollution and GHG make cities in developing countries less attractive to investors.

Batumi is, to a certain extent, in between two realities. There are 140 privately owned vehicles per 1000 persons, approximately three times fewer than in Western European cities and nearly twice less than in Tbilisi. However like elsewhere across Georgia, there is a growing tendency to buy cars for transportation. In Batumi air pollution and traffic congestion problems are far ahead of GHG emissions problems, thus an action plan to reduce GHG emissions from the transport sector will first include measures improving public transport services and road infrastructures. In the long-term perspective other measures related to the use of private vehicles and introduction of more efficient technologies will be envisaged.

As a result of measures implemented under the Batumi Sustainable Energy Action Plan, the transport sector's CO_2 emissions will be reduced by 12,700 tons $CO_{2\ eq}$ by 2020 against the baseline scenario.

Sectors and Fields of Activity	Core Measures by Separate Sectors	Department/Individual or Company in Charge/ if case the third party is involved	Start/End Date	Cost	Estimated Energy Saving from Activity (MW.h)	Expected CO2 Emission Reduction from Activity (t)
Public Transport	Activity PB1. Public Transport Management: • create bus transfer terminals; • Bus rapid transit; • reduce # of mini-buses and optimize routes; • procure compressed natural gas buses	Batumi City Hall Transport Department, Batumi Bus Company	2015-2024	GEL 3 mln. by 2017	42 108	10 000
	Activity PB2. Develop electric taxi services	Batumi City Hall	2015-2020	GEL7.5 mln.	1882	538
Private and Commercial Transport	Activity PRT1. Create public parking system	Batumi City Hall	2015-2016	GEL1.4mln	1 511	380
Transport and Traffic Planning	Activity UP1. Rehabilite and develop transport infrastructure	Batumi City Hall	2014-2016	GEL600mln.	2 912	975
	Activity UP2. Create pedestrian and cycling routes	Batumi City Hall	2014-2020	GEL1 mln.	2 330	780
Total				GEL 13.5 mln.	**50 743**	**12 673**

Table 17. Transport Sector Action Plan

DETAILED DESCRIPTION OF ACTIVITIES

Activity PB1. Public Transport Management

After the collapse of the Soviet Union, the public transport system in Batumi, like in other parts of the country, disappeared. Today the city is undergoing a revival where investment is being made in all sectors, including public transportation. The number of municipality-owned buses has increased from 20 to 130 with a potential to serve 180,000 people, which is equal to the entire population of the city. However, the initial route plan was not designed for passenger transportation from one route to another, which means there are many inefficient parallel routes. These inefficient routes impact the system financially by unnecessary energy consumption and more carbon emissions. Batumi has developed a public transport management plan to address the many problems it faces and according to estimates, it could save 10,000 tons of carbon annually. The following measures are planned:

- Create two bus transfer terminals

Create two transit terminals in Batumi to allow passengers to move freely throughout the entire city. A new Bus Rapid Transit system will connect the two terminals with each other at two-minute frequencies. This will be a new system for Georgia and the entire region. The central terminal will be located near the railway station or in the central Tbilisi Square, while the second one will be located to the south in the vicinity of the airport. Through these terminals, passengers travelling from other cities and regions will have access to Batumi municipal transport. Regional mini-bus circulation in the city center will be banned, and all arriving passengers will take municipal public transport.
The proposed specifications for two terminals are given in Table 18.

Table 18. Specifications for transfer terminals

Parameters	City main terminal	Batumi southern terminal
Estimated construction costs	500,000 Gel	500,000 Gel
Minimal space (square meter)	1000 m2	700 m2
Space for shops etc.	200 m2	100 m2
Total minimum number of bus stops	8	4
Minimum number of buses per hour	40	30

- Bus Rapid Transit

A new rapid line will be added to connect passenger transfer terminals at 2-minute frequencies with one bus per 500 meters to connect the terminals.

- Minibus reduction plan and route optimization

Since 2015, FAW-type buses can be possibly introduced to a new bus route network, for the rapid bus line that will run in 3-minute intervals at first, and in 2018 every 2 minutes. A market share under the 2014-2024 minibus reduction plan, i.e. 2014-2015, 2018-2019 and 2022-2023, is given below. It includes estimates on inconveniences that the transport may cause to the population.

Table 19. Market share adjustment plan for buses and minibuses

Year	Available buses	Number of passengers per day	Passengers per bus	Available minibuses	Number of passengers per day	% buses	% minibuses
2014	107	50,000	10.6	420	80,000	38%	62%
2015	107	80,000	18	230	50,000	62%	38%
2016-17	107	80,000	18	230	50,000	62%	38%

2018	124	90,000	16	185	40,000	69%	31%
2019	124	105,000	18	100	25,000	81%	19%
2020-21	124	105,000	18	100	25,000	81%	19%
2022	124	115,000	20	40	15,000	88%	12%
2023-24	124	115,000	20	40	15,000	88%	12%

Along with reducing the number of minibuses, it will also be necessary to plan six new minibus lines. One will be initially introduced to serve the industrial district, then five lines will be introduced beginning in 2018, and integrated into the bus transport system, and will connect the transfer terminals. By 2022, there will be only six minibus lines in the city.

- Procure new buses

The chart below shows the number of available and future buses, except Bogdan-type buses, that should be replaced soon. It will be necessary to procure additional 25 FAW-type buses by 2018 to reduce the BRT line stops from 3 to 2 minutes and add a FAW-type bus line to the Sarpi border stop by 2018.

Year	12 –meter bus	10-meter bus
2014	21	101
2015 to 2017	21	101*change can possibly begin*
2018 to 2024	46 to be *change in 2020*	101 all buses should be changed.

This number includes an approximately 20% reserve share by 2018; and 38 FAW-type and 86 Zonda-type buses put into operation. All new buses will be fueled by natural gas which will reduce both the emissions and expenses.

- Estimated cost and subsidies

The public bus company is presently in financial distress and would require a 55% government subsidy. Whereas, in Europe, 70% of public funding is common and the ticket price is considerably higher (from 2 to 5 Gel). In Europe, buses are less used, since the population has more income and despite good transport services people prefer to travel by personal vehicles. However, the main reason for Batumi bus company's financial difficulties is the competition from minibus companies which provide better service. The same ticket price will be maintained until 2019, then increased from .30 Gel to .40 Gel. If this plan is carried out, by 2022 there will be little or no need for public funding (excluding depreciation) except in the case of inflation, and salaries and petrol price increases.

Cutting down on the number of minibuses does not require increased budget expenses. However, other factors should be considered when replacing them with buses—buying more buses, adding bus stops, creating transit terminals, improving infrastructures, etc. These must be budgeted through municipal funding, private sector and/or international financial institutions.

Table 20. Public transport optimization-related expenses for 2015-2018

Year	Measures	Funding (GEL)	Source of funding
2015-2016	Procure 20 natural gas buses	2 000 000	International financial organization
2016-2018	Create additional stops, transit terminals (2 units)	1 000 000	Batumi budget, private sector

Emissions calculations assumed that 124 buses will be operating by 2020, including 20 natural gas buses and 100 minibuses. The distance covered by minibuses and buses will increase by approximately 50% as a result of their increased service frequency and new routes. Energy savings will amount to approximately 42,000 MW.h, and 10 thousand tons CO2eq of GHG emissions.

Activity PB1. Introduction of Electric Taxis

This activity will introduce electric taxis in Batumi and replace fossil-fuel ones. A project proposal has been elaborated and the search for funding is underway. This aims to demonstrate, through Batumi's example, the advantages of electric taxis over those with internal combustion. Overall 100 electric motor taxis will be imported and the corresponding infrastructure provided as part of the project. Afterwards, these taxis will be transferred to the private sector through various buyout schemes. If the project is successful, Batumi City Hall plans to further increase the number of electric taxis (as a long-term strategic objective), especially in the tourism sector. This will considerably reduce the environmental impact of the transport sphere. Apart from environmental objectives, another objective is to increase order in the sphere of taxi services and expel outdated taxis through increased competition. If this activity succeeds, the municipality plans to facilitate a 70% replacement of the taxi fleet with electric taxis in the following 10 years. Reduced emissions calculated by the replacement of 100 petrol-driven taxis with electric-driven Tesla Roadster vehicles with an approximate consumption of 17.4kW.h per 100 km will amount to approximate emissions reductions of 538 tons CO2eq.

Activity UP1. Rehabilitate and develop transport infrastructure through the following activities:

- Rehabilitate and improve road surfaces;
- Plan and develop bypass transit routes;
- Construct tunnels and bridges to reduce travel distances;
- Install "Smart Traffic Signals" and a traffic signal control center

To these ends, Batumi City Hall has already initiated some activities listed in Table 21 below:

Table 21. Batumi local government's initiated and ongoing projects for rehabilitation and improvement of road infrastructure

#	Activities	Implementation Timeframe	Brief Description	Investment Cost	Which parameter does it influence and how	Data Source
1	Rehabilitate city streets, lay out new streets.	2005-2016	Repairing city streets has been underway since 2005. Part of them have been completed and most will be rehabilitated by 2016; 23 streets with a total length of 64 km have already been repaired. 4 new streets with a total length of 11,5 km. have been constructed and landscaped; A street connecting Sh. Khimshiashvili and Leonidze streets has been constructed. Reconstruction and construction of 6,6 km. Bagrationi Street has been launched	**100 million Gel**	Creating new streets will help reduce vehicle traffic in Batumi and replacing old asphalt pavement with new will reduce atmospheric emissions; adjusting and narrowing streets in the historic part of Batumi will limit vehicle traffic in that area and gradually these old streets will be designated as pedestrian areas with transportation only by environmentally friendly vehicles.	Batumi self-government
2	Construction of Ajara bypass road	2011 - 2016	A 30 km bypass road around the city will connect the Saroi-Choloki section The first stages of the work which includes construction of the Choloki-Ochkhamuri and Chakvi-Makhinjauri sections at a total length of 15,4 km, is currently underway.	**0.5 billion Gel**	The bypass road will ultimately reduce external and internal transit transport traffic city-wide and cut travel time and distance.	Ministry of Regional Development and Infrastructure of Georgia; Asian Development Bank (ADB); Engconsult, Canada; Sambo, Korea, Transproject, Government of Ajara AR

A traffic signal control center is being created, and 16 out of 30 traffic lights in Batumi are now “smart traffic signals”, and only 14 are ordinary ones. There is a central node in the Transport Infrastructure Agency’s office, connected to all traffic signals by optic cable. This allows monitoring traffic signals. A central video surveillance system, through which a video signal from each intersection is transmitted to a corresponding monitor, is also located in the control center. Using a software system, the central node can monitor and manage traffic signals. In the control center the location of the traffic lights is displayed on a digital map.

Pic. 1 Smart Traffic Signals

Road traffic management (and road infrastructure management) and the related reductions of GHG emissions is a complex and controversial process. Reducing traffic congestion through such measures as traffic signal control, green lines etc. will result in reductions of GHG emissions from individual vehicles since they will move more effectively. However, this may not lead to a total reduction of emissions, since reducing traffic congestion will make private vehicles more attractive. This will again result in higher emissions. One measure being considered is to ensure the steady, moderate-speed movement of vehicles, which is more efficient than the "stop-start" mode during periods of congestion. However, if such steady movement results in increase in the number of moving vehicles on roads, again it might lead to the growth of GHG emissions. Thus if reducing traffic congestion is combined with restricting private vehicle traffic, GHG emissions will actually decrease. These measures and their related emissions reductions could be considered only as part of a wider transport strategy, carried out with other activities in this document.

Based on evaluations[10] conducted for the emissions reduction assessment, data shows that as a result of these measures listed below, annual covered distance by transport will decrease by 1% by 2020. This will lead to emissions reductions of 975ton CO_2eq. by 2020.

Activity UP2. Facilitate Cycling and Walking

Facilitating cycling and walking is one of the most efficient and healthiest means to reduce emissions. In the short term the Batumi City Hall plans to facilitate cycling transportation for tourists and residents alike, while in the long-term private vehicle traffic will be banned from certain streets so they become pedestrian areas. Since 2011, City Hall has launched the “Batumvelo” project to facilitate cycling with special lanes allocated for this purpose. “Batumvelo” possesses 22 bike parks located along the Batumi seaside and central in places.

There are about 300 bicycles per park and in the future more parks will be placed across the city. In 2014, eight bike parks will be added. The project is implemented by the Government of Ajara AR, Batumi City Government and Batumi Autotransport Ltd. and costs 1 million Gel.

[10] Evaluations have been obtained by comparing and assessing measures planned under the Tbilisi SEAP.

Pic. 2. Batumvelo bikes

Pic. 3. Bike park terminal

In the longer term a pedestrian district will be created where private vehicle traffic will be banned. Most likely this will be located in the "Old Batumi" area between K. Gamsakhurdia, Gogebashvili, M. Abashidze and Chavchavadze Streets, and the Seaside park adjacent to Alphabet Tower, and Memed Abashidze Street. This area is characterized by narrow streets and interesting architecture. Today it is impossible to move easily in this area because of parked vehicles (see also Activity PRT1. Parking System Development). If well-planned, this area can be turned into a seaside boulevard, and an alternative tourist district with pedestrian streets, cafes and bars, museums and shops. However, first it is necessary to create a project integrated into the city's general urban plan and initiate citizen awareness raising and discussions to ensure the population understands the benefits. Consequently, this measure is considered within the long-term strategy.

The reduction of emissions made through cycling and pedestrian road measures has been calculated at approximately 1% of the need for road transport traffic or a savings of about 780 tons of emissions.

Activity PRT1. Parking System Development

Unauthorized parking on grass lawns, sidewalks, in front of driveways, etc has become a familiar sight in Batumi. The lack of enforcement means violations are common and cause accidents, traffic jams, and hampered pedestrian movement. The city, especially in the center, has become less comfortable for residents who live there. In addition to development the city must regulate the parking issue. In 2011, Batumi's City Council (Sakrebulo) set up Batumi Parking Ltd., which operates today with broader functions as N(N)LP Transport Infrastructure Management Agency. Their only task was to create parking lots (marking, special signs) and collect parking fees. As a result, 8000 parking spaces were created in Batumi and chaotic parking decreased, but the streets and parking areas remain congested. Particularly common is parking in restricted areas, double-parking, parking in front of exits or on sidewalks. Cones installed on sidewalks have turned out to be efficient. The seaside parking lots are equipped with parking meters (Pic.5; first time in Georgia, a total of 40 parking meters), that allow the payments of parking fees per hour. Meters are equipped with solar batteries and connected to the control post through a GPRS system. Parking meter payments differ according to seasons of the year and parking is free from 7 p.m. till 9 a.m. in winter (October 16 – May 31). A subscription fee is also available for the parking meter area. The final parking time (hour) is indicated on the printed receipt.

Parking fines amounts to: (see Table 22; Decree #4, dated February 28, 2013, of the City Council of the self-governing city of Batumi).

Table 22. Parking fine in Batumi

Number of Days	Amount (in GEL)
365	40
182	25
30	10
7	5
1	1

Fines for non-payment of parking fees or violations of parking rules amount to 10 Gel (Chart 16).

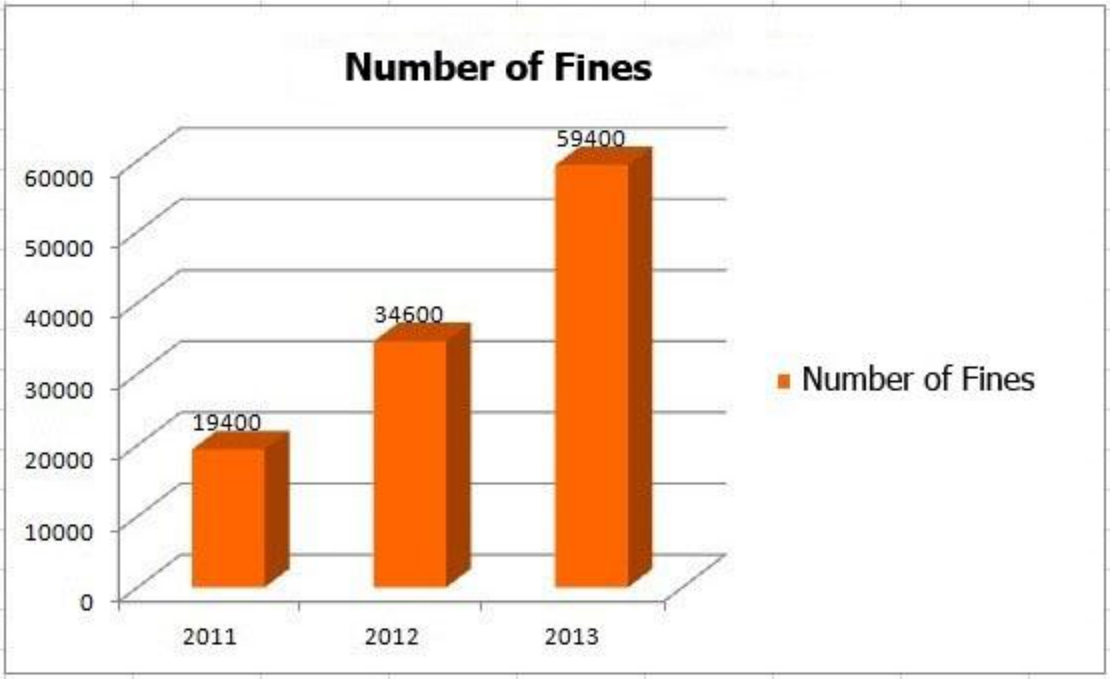


Figure 16. Number of parking fines in Batumi in 2011-2013

A sharp increase in the number of fines indicates the amount is too low. In neighboring Turkey, a similar fine in a city like Batumi amounts to the equivalent of $40; in London to approximately $160; and in Amsterdam to approximately $150, etc. In Batumi fines are not fulfilling their function as many drivers pay no attention to such low amounts. The amount of fines should be increased. Batumi parking policy can be planned to help decongest the city. Based on world best practices and with due consideration for the current situation in Batumi, it is possible to carry out several activities. *Objectives:* relieve main arteries, eliminate traffic jams, develop cheap public transportation; reduce noise and--most importantly for a tourist city—cut emissions sharply.

The central streets will either be completely traffic-free or parking fees will be so high that, except particular cases, it will not be beneficial for non-local car owners to enter the area--it will become cheaper for them to use public transport. This cuts the risks of being caught in traffic jams or having parking problems.

It is very important to create restricted or traffic-free zones where private vehicles will be completely banned and only public, special (police, ambulance, fire brigade) and delivery vehicle traffic is permitted (with short-term parking permits). Referring to Activity UP2., the Old Batumi area could be developed into such a zone. For instance, there are 120 parking spaces on Memed Abashidze Street, however approximately 400 vehicles park there, including 80-100 that violate parking regulations. This is why tourists and especially the local residents face serious problems. Based on western countries' experience, vehicle traffic for tourists can be banned completely; special parking lots can be created at the city entrance and they should travel into the city by public transport.

From a variety of approaches, an acceptable example for Batumi as a tourist city is Munich where parking lots have been created at the city entrance. A person pays a parking fee which also covers free municipal transport. The parking has no time limits—the car can be left for any period while its owners take the public transport, ride a bike or walk.

A similar approach is being considered with regard to buses and minibuses travelling to Batumi from other cities and villages. Recent observations prove that traffic and parking for these vehicles pose serious problems in Batumi. A bus park can possibly be possibly created in the vicinity of the Batumi Airport for bus traffic from Turkey; in the area adjacent to Leonidze Street near the former transformer factory for traffic from Upper Ajaria and Turkey); and near the Port area (for traffic from Tbilisi).

From 700-900 parking spaces should be created to implement a “restricted zone” plan. Underground and surface parking lots at zone entrances should give priority to individuals residing in restricted zones. For others it should become gradually more convenient to use public transport.

The diversification of parking fees is a prerequisite for unclogging the center. Current parking fees are half compared to 2011, and are based on one’s income. A one-year parking fee is 40 Gel, or 11 Tetri per day. In principle it is possible to park a vehicle for 24 hours at .11 Gel anywhere in the city, including in central districts. It would be more effective if parking fees are paid through meters rather than subscriptions. This would not apply to those living in the district, however, who would access a special subscription fee to be introduced for them, permitting them to park their vehicles near their home. This is an effective practice in many European cities. Subscription fees can be maintained in other districts of the city but they will differ depending on the distance from the city center (also a proven method in the European cities).

Fees for underground and surface rotary or elevator parking lots are matters for separate discussions. Establishing parking fees is a prerogative of the parking building owner. Parking meter fees will cost 3-5 Gel/hour and will be limited to 1 or 2 hours. The present 40 units of parking meters is insufficient for achieving the objective; at least 150 should be added. The number of parking spaces will add up to 2000-2500 in the center (instead of 5000) for parking meters, while 2000-2500 parking spaces will be reduced in the seaside area – in Gogebashvili, Ninoshvili, Khimshiashvili and adjacent streets. Results will include:

a) Using private cars will be neither financially beneficial nor convenient (costly and time-limited parking);
b) The city’s central districts will be freed from private vehicles;
c) Public transport and cycling systems will be developed;
d) Road and information signs will be improved.

Carrying out the parking policy requires an approximately 1,400,000 Gel investment by the City Hall. A donor will be found for approximately $30,000 i and the private sector will be engaged in planning parking lots. The total budget is shown in the table:

Table 23. Parking measures budget

№	Measure to be taken	Finance Source			Estimated Budget (US$)
		City Hall	Donor	Private Sector	
1	Relevant regulatory changes regarding tougher sanctions for violation of parking regulations	5 000			5 000
2	Public awareness-raising working meetings, workshops and promo events for private car owners and commercial sector (investors)		25 000		25 000

3	Allocating land in the city for parking meters and constructions of underground and surface multi-level parking facilities	10 000	5 000		15 000
4	Procuring and installing 110 parking meters	1 100 000			1 100 000
5	Parking meter software	70 000	30 000		100 000
6	Staff training on software and maintenance		30 000		30 000
7	Parking space equipment including new road signs	150 000			150 000
8	Design planning and proposal for underground and surface multi-level parking facilities	70 000	30 000		100 000
9	Construction of 1 underground multi-level parking facility designed for 250 vehicles and 2 surface rotary-type multi-level parking facilities designed for 250 vehicles.			28 500 000	28 500 000
10	**Total**	**1 405 000**	**120 000**	**28 500 000**	**30 025 000**

It is difficult to estimate parking policy efficiency without taking into account other measures. However, according to the mitigation measures guidelines for transport sector, a 10% increase in car parking costs leads to a 3% drop in car ownership. It has been estimated that if parking policy decreases car ownership only by 1%, there will be an annual savings of 380 ton CO_2eq. emissions.

Other measures: it is expected that the technical inspection of vehicles will become mandatory in Georgia beginning in 2015, although details have not been determined. Batumi City Hall will cooperate with other municipalities and national agencies to develop uniform vehicle and fuel standards in line with European ones. This will reduce fuel consumption and GHG emissions, as well as local pollutants and improve living and health conditions. Technical inspections will make for better maintenance and technical equipment of vehicles. Under the mitigation measures guidelines for the transport sector,[9] fuel consumption of well-maintained vehicles can be reduced by 3-7%, resulting in emissions reductions. Since most vehicles in Georgia are outdated and inefficient, these measures may be effective, although no particular measures have yet been planned by Batumi City Hall.

BUILDINGS

Sector Overview

The Batumi buildings sector is one of the most important components of the Sustainable Energy Action Plan, and includes residential as well as municipal, commercial and other facilities. Reducing energy consumption in these buildings is an important prerequisite for lower GHG emissions so measures aiming at growth of energy efficiency and renewable energy exploitation need special planning.

Pic. 4. Energy efficient buildings in Batumi

The Batumi Residential Buildings Sector

The territory of Batumi covers an area of 6494.31 hectares. The city grew twice—first in 2009, after adding 25m2 of Khelvachauri Municipality and in 2011, as a result of joining significant parts of Khelvachauri and Kobuleti Municipalities. The population is now 170,000.

No inventory has been made of existing buildings recently, thus it is difficult to determine quantitative data and conditions of Batumi buildings. Although a full inventory of buildings is planned for 2014 there are some preliminary data on the city's buildings.

According to Batumi City Hall, there are now 16,648 residential buildings with total area of 3,385,150 m2 of which 1,627,370 m^2 make up 15,917 individual residential houses. Details are found in the Table below.

Table 24. Fund of residential buildings of Batumi

N	Number of Storeys	Quantity	Total area (m^2)
1	1-2-storey individual	15 917	1 627 370
2	2-storey	278	41 700
3	3-storey	59	59 000
4	4-storey	90	175 500
5	5-6-storey	107	579 600
6	7-9-storey	137	704 180
7	10-16-storey	60	197 800
	Total	**16 648**	**3 385 150**

Almost 90% of the residential buildings date from the pre-1990s Soviet period and are often of uniform construction. About 10-15% have depreciated or out of use. Newly built residential buildings are usually multistoried. Information about quantity and area of buildings and the list of constructions owned by Batumi Municipality are shown in Tables 25 and 26.

Table 25. Total number and area of constructions in Batumi

№	Building type	Quantity	Area, m^2
	Recreational facilities		
1	Outdoor swimming pools;	2	1 800
2	Playgrounds;	3	4 500
3	Botanical Garden ;	1	1 110 000
4	Squares;	40	105 600
5	Parks;	5	215 000
6	Children's Playgrounds;	50	4 000
7	Boulevards;	1	1 050 000
	Buildings		
8	State Kindergartens;	22	11 440
9	Multifamily and single-family houses;	16 959	1 800 000
10	Individual entrepreneurial and non-entrepreneural activity workrooms;	350	35 000
11	Other pre-school institutions;	7	1 680
12	Schools;	35	87 500
13	Pharmacies;	150	4 500
14	Commercial shops;	1 200	54 000
15	Groceries;	1 500	75 000
16	Post offices, Communication departments;	3	330
17	Bank branches/ departments;	30	5 100
18	Outdoor above-ground or underground parkings. Multi-storey car parks	250	105 000
19	Orangery and greenhouses;	10	2 000
20	Medical centers;	40	4 400
21	Gyms;	10	1 500
22	Cinemas;	1	750
23	Information Centers;	25	50
24	Exhibition halls;	2	200
25	Dance and disco halls;	25	3 750
26	Bars, cafes;	65	5 200
27	Fast food restaurants;	30	660
28	Utility services	48	480
29	Kiosks, temporary pavilions, retail facilities;	55	385
30	Notary office;	20	700
31	Churches;	25	
32	Police offices;	20	4 000
33	Hotels big and medium;	50	
34	Municipal and engineering facilities;	35	1 925
35	Petrol stations and / or transportation services;	50	20 000
36	Secondary and vocational training institutions;	1	2 500
37	Individual, agricultural and technical facilities;	15	2 250
38	Houses for elderly people;	2	1 300
39	Hospitals;	10	9 100
40	Indoor swimming pools;	5	6 500

41	Theaters;	4	4 800
42	City libraries;	2	2 500
43	Archives;	1	3 200
44	Museums;	5	2 250
45	Restaurants;	25	5 000
46	Offices and bureaus;	480	21 600
47	Courts;	1	2 250
48	Fire depots;	4	6 000
49	Public toilets;	15	38
50	Swimming facilities (ports, harbors, piers)	13	15 000
51	Changing rooms, showers, public toilets;	20	40
52	Open inventory warehouses of beaches;	10	300
53	Rescue Service Stations;	15	750
54	Casinos, Slot machine halls, billiard, etc.;	20	4 400
55	Zoos;	1	1 000
56	Administrative buildings	85	19 000
	Total	21 851	4 824 428

Table 26. List of buildings owned by Batumi city municipality

№	Property Name	Quantity	Area, m^2
1	State kindergartens;	22	11 440
2	Retirement homes;	2	1 300
3	City libraries;	2	2 500
4	Fire stations;	4	6 000
5	Administrative buildings.	85	19 000
	Total	115	40 240

The city is divided into 13 administrative units. Despite the fact that they are roughly equal in size, the newly added territories have more low-rise residential houses.

Table 27. List of private houses

Low-rise houses	Number of Buildings	Dwelling Space m^2	Land Space m^2
1-storey	5 850	438 750	438 750
2-storey	6 817	749 870	681 700
3-storey	3 250	438 750	357 500
Total	15 917	1 627 370	1 477 950

The north-western area is historic Batumi where houses were built at the end of the 19th and the beginning of the 20th century.

Table 28. List of residential buildings constructed before 2000

Residential blocks	Quantity of blocks	Dwelling space m^2	Land Space m^2
3-storey	52	52 000	26 000
4- storey	81	131 625	56 700
5 - storey	175	341 250	122 500
8 - storey	1	2 800	1 500

9 - storey	110	586 300	143 000
10 - storey	1	6 000	1 500
12 - storey	35	91 000	17 500
16 - storey	1	6 000	1 200
Total	456	1 216 975	369 900

Newly built residential buildings are usually multi-storey (Table 29).

Table 29. Residential buildings in Batumi according to the data of 2013

Residential building	Number of buildings	Dwelling Space m^2	Land Space m^2
2-storey	278	41 700	41 700
3-storey	59	59 000	29 500
4-storey	196	548 800	137 200
5-storey	11	30 800	8 800
6-storey	6	18 600	7 200
7-storey	5	14 000	7 500
8-storey	126	671 580	163 800
9-storey	6	36 000	9 000
10-storey	42	109 200	21 000
12-storey	1	2 600	1 300
13-storey	3	18 000	3 600
16-storey	8	32 000	12 000
Total	**831**	**1 757 780**	**505 600**

Current State of the Buildings Sector

Since 90% of the residential buildings of the city were built during the Soviet period, they are of uniform standard. Many have depreciated and some are vacant. A city inventory mentions three main types of constructions: residential buildings, commercial facilities and administrative buildings including state institutions, kindergartens, schools, hospitals etc. Most of the last two are located in the center, however in future nonresidential buildings will be constructed in other areas. Industrial and manufacturing facilities are mainly found in the outlying areas of the city. Most have medium or low production capacity.

There are 606 barrack- type-housing constructions in Batumi, which are substandard facilities and inadequate for living, but built quickly in the aftermath of natural disasters or conflicts in breakaway regions. The Batumi Government developed a program called “Batumi without barracks” in 2009, which is being implemented gradually. Between 2009 and 2013 approximately 250 barrack type buildings were destroyed and residents re-housed in apartment blocks.

According to the data of 2014, there are 60 houses under threat of collapse, many of which are 2-4-storey buildings. Repair of most of these is planned within the 2014-2015 Batumi budget.

Measures implemented in the buildings sector

Batumi encourages cooperative programs within residential buildings that include roofing, yard improvement, water and sewerage pipe replacement and elevator repairs. Based on 2013 data, roofing works were carried out in 353 multi-storey apartment blocks, and 450 yards improved. Approximately 50 new roofing works are planned in 2014, although this doesn't include roofing for private and barrack type houses, although there are exceptions. Table 30 contains information on roofing and yard improvement activities:

Table 30. Works accomplished in 2007-2013

Apartment block	Quantity of blocks	Roofing	Yard Improvement Activities
2-storey	278	75	100
3-storey	59	20	14
4-storey	90	40	43
5-storey	196	95	150
6-storey	11	3	5
7-storey	6	4	7
8-storey	5	4	5
9-storey	126	83	80
10-storey	6	3	6
12-storey	42	25	12
13-storey	1	-	1
16-storey	3	1	3
16-storey and more	8	-	8
Standard Private Residential Buildings	15,917	-	-
Barracks	606	-	-
	17,354	**353**	**434**

A Cooperative Support Program also works to install main entrance doors, and up to 100 such cooperatives installed entrance doors within the framework of the program.

One of the most important initiatives is project "Cheap Housing" that aims at providing residents with affordable and adequate quality housing. This goal will be achieved through the creation of long-term buy-out mechanisms. The main focus will be on energy efficiency and the intelligent use of resources, and closely connected to the SEAP.

Infrastructure projects implemented in the Batumi buildings sector:

- 12 state institutions were repaired and rehabilitated (2010-2013);
- 10 state-owned buildings were renovated (2010 – 2013);
- Construction of a private hospital "Medina" was completed (2011);
- Construction of new Referral Hospital finished (2012);
- Two Outpatient Clinics were renovated;
- 20 public schools were rehabilitated (2008-2013);
- 10 kindergartens were rehabilitated and 2 new ones built (2010-2013);
- 4 large business and shopping centers were constructed (2008 – 2013);
- The Public Library of the City underwent compete renovation (2012);
- 10 large hotels, with 1200 total # of rooms built (2008-2013);

- 150 barracks were dismantled (2009-2013);
- The number of small family-type hotels increased by 7-8% annually (Data of Tourism Department);
- 35 residential buildings were constructed at a total area of 230,000 m^2(2005-2013);
- 12 houses were repaired and one building was demolished. Most are 4-5 storey residential blocks (2010-2013);

The list of infrastructure projects planned for 2015-2020 in the Batumi buildings sector is given below.

Table 31. Infrastructure projects planned for 2015 - 2020

#	Type of Building	Quantity	Built in 2000-2013	Built before	Activities Implemented or Planned
1	State Institutions (Ministries, Government buildings)	85	35	50	Repair of a new City Hall with a total space of 1250 m^2 is planned for 2015
2	Buildings for state-owned organizations	145	110	35	Repair of 2 buildings and full rehabilitation of 1 new one is planned for 2014
3	Hospitals	10	5	5	Termination of 1 hospital planned for 2014
4	Polyclinics	40	7	33	-
5	Schools	35	4	31	Construction of 2 new schools and rehabilitation of 3 old ones planned for 2015-2017
6	Kindergartens	29	5	24	Construction of 2 new kindergartens planned for 2014
7	Large shopping malls and Business Centers	35	10	25	2 new business centers planned for 2014
8	Libraries	2	1	1	Repair of the main library of the city planned for 2014-2015
9	Large hotels	30	12	18	Opening of 2 large hotels planned for 2014 - 2015
10	Barracks type housing	606	-	606	Probably 77 state memorandums owned residents will be satisfied in 2014. Complete demolition of barrack-type houses is planned for 2015-2017
11	Commercial facilities	3568	180	3388	-
12	Family type small hotels	150	-	150	Inventory of family type hotels is planned for future
13	Residential houses	16 128	250	15878	Construction of 25 new residential blocks and 5 new 150- flat economic housing for 2015 – 2020
14	Houses under threat of collapse	60	-	60	Full repair or demolition of houses under the threat of collapse planned for 2014 - 2015

Most buildings do not meet energy conservation requirements. Many have open entrances, thin walls, and damaged frames, single glazed wooden windows, low thermal resistance coefficient and low coefficient for exterior thermal characteristics. The following is a partial list of those gaps that show why these buildings have large energy losses and potential to save energy.

Total Energy Consumption in Batumi

Values of energy resources consumed by municipal, commercial and residential buildings in 2012 are given below.

Table 32. Energy resources consumed by municipal, commercial and residential buildings in Batumi throughout 2012

№	Year	Electricity, kW*h	Natural gas, m^3	Firewood, m^3	Liquid gas, t
1	Municipal buildings	18 520 100	181 125	110.0	7. 818
2	Commercial buildings	85 754 756	3 369 750	0.00	0.00
3	Residential buildings	141 368 820	16 351 625	29 890	5 097. 706
	Total	245 661 800	19 902 500	30 000	5 105. 223

Methodology

The methodology for determining the CO_2 baseline (2012) emission inventory and future trends (up to 2020) for the Buildings Sector was the same as described in the Transport Sector. See the following table for details (Table 33).

Table 33. Methane and Nitrous Oxide Emission Factors for Buildings (kg/MW/h)

Greenhouse Gas	Natural Gas	Oil Products	Firewood
CH_4	0.018	0.036	1.08
N_2O	0.00036	0.002	0.014

Emissions reduction potential after energy saving measures have been assessed through selecting buildings typical for Batumi, carrying out energy audits and evaluating energy efficiency measures, then extending these results to other buildings. The methodology is described in more detail. Buildings, such as residential houses, schools, hospitals, kindergartens, hotels, educational institutions, shops, offices etc. have significant potential for energy conservation. Determining the actual potential of energy conservation requires optimal methods and the means to conduct an energy audit. This includes building studies, situation assessments and evaluations as well as other measures to reduce energy consumption and improve the buildings' microclimate. Results are reflected in the energy audit report that will describe recommended measures with appropriate investments, savings and profits. The energy audit has to be conducted by trained and experienced energy auditors.

It is impossible to assess energy-saving potential in a building only by simple accounting or fixing annually consumed energy quantities (e.g. 700,000 kWh/y). This figure does not show building size. A clear picture on energy efficiency of buildings is given by specific energy consumption i.e. energy consumed per m2 annually. However, there are other factors such as building type (administrative, hospital, school etc.), weather conditions, insulation, etc. that influence energy consumption. Therefore specific energy consumption must be compared with "standard" key numbers of the country.

Key numbers should reflect model values of specific energy consumption and take all mentioned factors into account. Comparing measured and calculated values with key numbers permits the rapid evaluation of energy efficiency and energy-saving potential of buildings. Specific energy consumption rates also indicate the energy efficiency of a building just as fuel consumption per mile defines the energy efficiency of a car.
Significant reductions on energy expenses in buildings can be made by energy consumption management, filling open holes in outside walls, automating administration, automating hydraulic balancing of heating systems, installing thermostatic valves on radiators, adding insulation to constructions and other measures.

An energy audit should be carried out to assess buildings' energy saving potential, as it would take into consideration factors such as insulation (walls, windows, roofs, floors), heating systems, ventilation systems, hot water supply systems, automated management systems, lighting, miscellaneous equipment and airconditioning systems. An energy audit is divided into six important steps: project identification, scanning, energy assessment, business plan, implementation (realization) and exploitation.

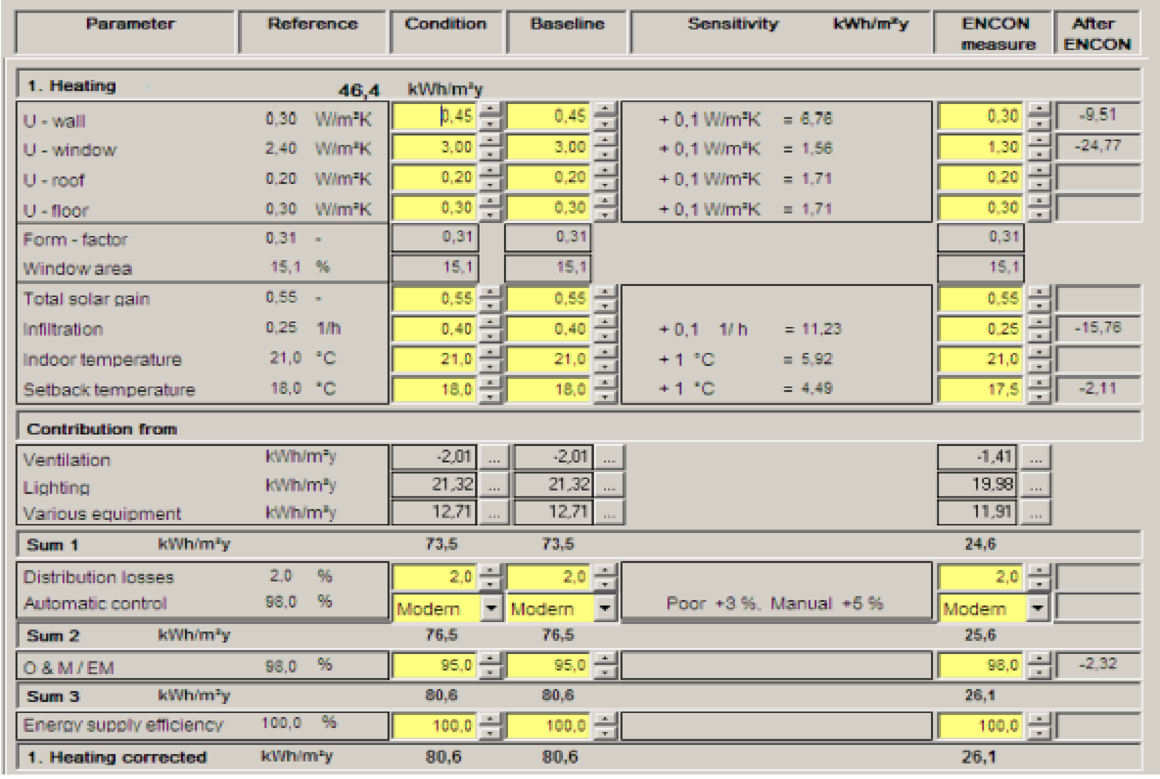
Guidelines on energy consumption of buildings have been drawn up to create energy and power consumption budget standards. It is based on eight articles: heating, ventilation, hot water supply, fans/pumps, lighting, miscellaneous equipment, cooling and outdoor equipment. The budget is divided into eight sectors, which facilitates the modification of energy and power consumption annually. Overall annual energy consumption (kWh/y) has to be determined as well as specific annual energy consumption values (energy consumption for 1 m^2 space heating. kWh/m^2y). The budget for residential and household buildings can be simplified to three articles: heating (including natural ventilation); hot water supply; and household (lighting, appliances, farm equipment, etc.).

An energy audit of typical Batumi buildings has been conducted using “Key Numbers” from ENSI software. The Norwegian Consulting Company ENSI, founded in 1992, developed a simple software “Key Number” for a rapid calculation of energy issues that can be applied to plan new buildings and when renovating existing buildings. Key figures reflect model values of specific energy consumption in buildings according to given factors. This enables rapid comparisons of measured and calculated values of energy consumption to assess energy efficiency and energy saving potential.

ENSI software provides a database for each energy budget article and reflects data obtained after carrying out energy-saving measures. For example, the ENSI software format in energy budget article “Heating” is divided into columns: the first column contains the most important “parameters” affecting energy required for heating. The second column shows model values of each parameter based partly on construction standards, rules and regulations and partly on experience from similar projects (Pic.12 ENSI Software format for Energy Budget).

The third column, “condition” includes existing technical conditions of the building selected for an energy audit and the “measured energy consumption” required for heating (kWh/m^2 y).

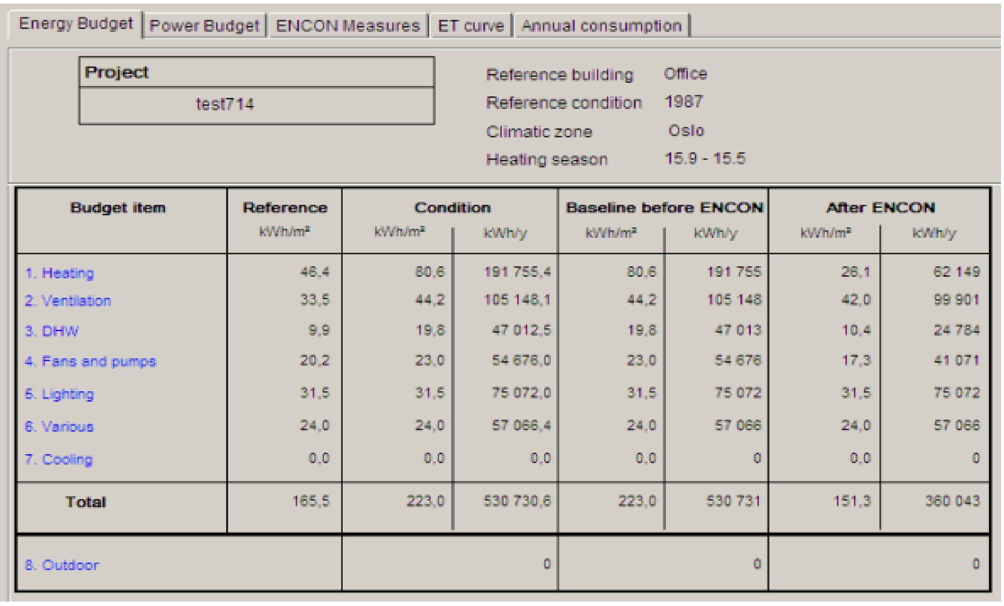
The existing conditions of buildings in Georgia differs substantially from the norm. Thus, measured energy consumption may be higher de facto, than those calculated (e.g. due to water leaks or improper operation of a heating system) or consumption may be less (e.g. due to heating or ventilation system shutdowns). Along with energy-saving measures, an owner might need to improve the overall microclimate in the building, for example by installing an air ventilation system or increasing the efficacity of an existing system. These measures will lead to increased energy consumption.
Since, in most cases, “measured energy consumption” does not coincide with “estimated energy consumption”, the calculated values of energy consumption in the fourth column of the ENSI software have to be used as a “basic line” to get accurate values of energy economy. The “ENCON measure” contains alternative energy saving solutions and measures, and the “after ENCON” column (savings per parameter/measure) lists the savings.



Parameter	Reference	Condition	Baseline	Sensitivity	kWh/m²y	ENCON measure	After ENCON
1. Heating	46,4	kWh/m²y					
U - wall	0,30 W/m²K	0,45	0,45	+ 0,1 W/m²K	= 8,78	0,30	-9,51
U - window	2,40 W/m²K	3,00	3,00	+ 0,1 W/m²K	= 1,56	1,30	-24,77
U - roof	0,20 W/m²K	0,20	0,20	+ 0,1 W/m²K	= 1,71	0,20	
U - floor	0,30 W/m²K	0,30	0,30	+ 0,1 W/m²K	= 1,71	0,30	
Form - factor	0,31 -	0,31	0,31			0,31	
Window area	15,1 %	15,1	15,1			15,1	
Total solar gain	0,55 -	0,55	0,55			0,55	
Infiltration	0,25 1/h	0,40	0,40	+ 0,1 1/h	= 11,23	0,25	-15,76
Indoor temperature	21,0 °C	21,0	21,0	+ 1 °C	= 5,92	21,0	
Setback temperature	18,0 °C	18,0	18,0	+ 1 °C	= 4,49	17,5	-2,11
Contribution from							
Ventilation	kWh/m²y	-2,01	-2,01			-1,41	
Lighting	kWh/m²y	21,32	21,32			19,98	
Various equipment	kWh/m²y	12,71	12,71			11,91	
Sum 1 kWh/m²y		73,5	73,5			24,6	
Distribution losses	2,0 %	2,0	2,0			2,0	
Automatic control	98,0 %	Modern	Modern	Poor +3 %, Manual +5 %		Modern	
Sum 2 kWh/m²y		76,5	76,5			25,6	
O & M / EM	98,0 %	95,0	95,0			98,0	-2,32
Sum 3 kWh/m²y		80,6	80,6			26,1	
Energy supply efficiency	100,0 %	100,0	100,0			100,0	
1. Heating corrected	kWh/m²y	80,6	80,6			26,1	

Figure 17. ENSI software format for Energy Budget Article "Heating"

A similar structure is used for other articles of the energy budget (ventilation, hot water supply, fans and pumps, lighting, other equipment, cooling and outdoor equipment). Results are collected in "energy budget" table.



Energy Budget | Power Budget | ENCON Measures | ET curve | Annual consumption

Project: test714

Reference building: Office
Reference condition: 1987
Climatic zone: Oslo
Heating season: 15.9 - 15.5

Budget item	Reference	Condition		Baseline before ENCON		After ENCON	
	kWh/m²	kWh/m²	kWh/y	kWh/m²	kWh/y	kWh/m²	kWh/y
1. Heating	46,4	80,6	191 755,4	80,6	191 755	26,1	62 149
2. Ventilation	33,5	44,2	105 148,1	44,2	105 148	42,0	99 901
3. DHW	9,9	19,8	47 012,5	19,8	47 013	10,4	24 784
4. Fans and pumps	20,2	23,0	54 676,0	23,0	54 676	17,3	41 071
5. Lighting	31,5	31,5	75 072,0	31,5	75 072	31,5	75 072
6. Various	24,0	24,0	57 066,4	24,0	57 066	24,0	57 066
7. Cooling	0,0	0,0	0,0	0,0	0	0,0	0
Total	165,5	223,0	530 730,6	223,0	530 731	151,3	360 043
8. Outdoor			0		0		0

Figure 18. „Energy Budget"

The methodology for evaluating CO_2 emissions includes database development and corresponding calculations according to three scenarios. The first is based on annual energy data, the second on data about buildings, and the third on demographic data. According to the first scenario makes it possible to estimate an annual energy consumption on the basis of annual statistical data of consumed natural gas, electricity and firewood (E1, kW*h/y).

The second scenario needs a detailed energy audit for different types of pre-selected buildings (typical buildings) and estimates on specific energy expenditures (energy consumption per m^2, $kW*h/m^2y$) for heating, cooking and electrical equipment. Energy audits conducted via optimal methods and the software format would allow us to determine the real potential for energy savings. This involves a situation assessment and analyses and other measures to reduce energy consumption and therefore CO2 emissions. After clarification, specific figures on energy consumption and annual consumed energy for heating, hot water, cooking and electrical equipment becomes possible (E2, kW*h/y) for various types of buildings.

The third scenario is based on statistical data about the number of people living in the area. Determining per capita energy consumption (kWh/y per capita) can be extrapolated to calculate annual energy consumption for an entire population (E3, kW*h/y).

Finally, cross-comparisons of these findings make it possible to determine the accuracy of calculations for each scenario under the condition that (E1 = E2 = E3).

Base Year (2012) Inventory and GHG Gas Emissions- BAU Scenario (2013 – 2020)

The Buildings Sector structure of Batumi includes three sustainable energy sub-sectors: municipal buildings, residential buildings and other (commercial buildings). The data are based on the energy consumed throughout 2012 as given below.

Table 34. Total Energy Consumption in Batumi Buildings Sector – 2012

N	Subsector	Electricity	Natural Gas	Liquid Gas	Diesel	Firewood	Total
1	**Municipal Buildings**	18 522	1 690	103	0	229	**20 544**
2	**Other (commercial) buildings**	85 762	31 444	0	0	0	**117 206**
3	**Residential Buildings**	141 380	152 582	67 040	0	62 276	**423 278**
	Total	**245 663**	**185 716**	**67 143**	**0**	**62 505**	**561 028**

GHG emissions from buildings amounted to 87.8 thousand tons $CO_{2\ eq}$ in 2012.

Table 35. GHG emissions from Batumi Buildings Sector CO_2 –eq. (t) - 2012

N	Subsector	Electricity	Natural Gas	Liquid Gas	Diesel	Firewood[1]	Total
1	**Municipal Buildings**	2 519	340	23	0	6	**2 889**
2	**Other (Commercial Buildings)**	11 664	6 335	0	0	0	**17 998**
3	**Residential Buildings**	19 228	30 738	15 239	0	1 690	**66 895**
	Total	**33 410**	**37 413**	**15 262**	**0**	**1 697**	**87 782**

The driving parameters of buildings sector energy demands and consumption are towards an increase in fuel consumption, as projected by the MARKAL-Georgia national model. This model is based on population growth, GDP growth and GDP growth per capita in the city. Details on the methodology are described in the “Transport” chapter. According to the MARKAL-Georgia national model, GHG emissions growth rates are as follows:

Table 36. Fuel Consumption Growth Rates for Different Building Types under the BAU Scenario

N	Sector	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	Municipal & Commercial Buildings	1	1.1	1.21	1.3	1.37	1.44	1.5	1.55	1.6
2	Residential Buildings	1.04	1.08	1.12	1.17	1.21	1.26	1.31	1.37	1.42

In the absence of local projections of gross domestic product and population growth, the national projections without modifications have been applied for Batumi. According to the baseline scenario of growth, GHG emissions from Buildings Sector will reach 18,500 tons of $CO_{2\ eq.}$ by 2020. Emissions increases in Buildings Sector is given below:

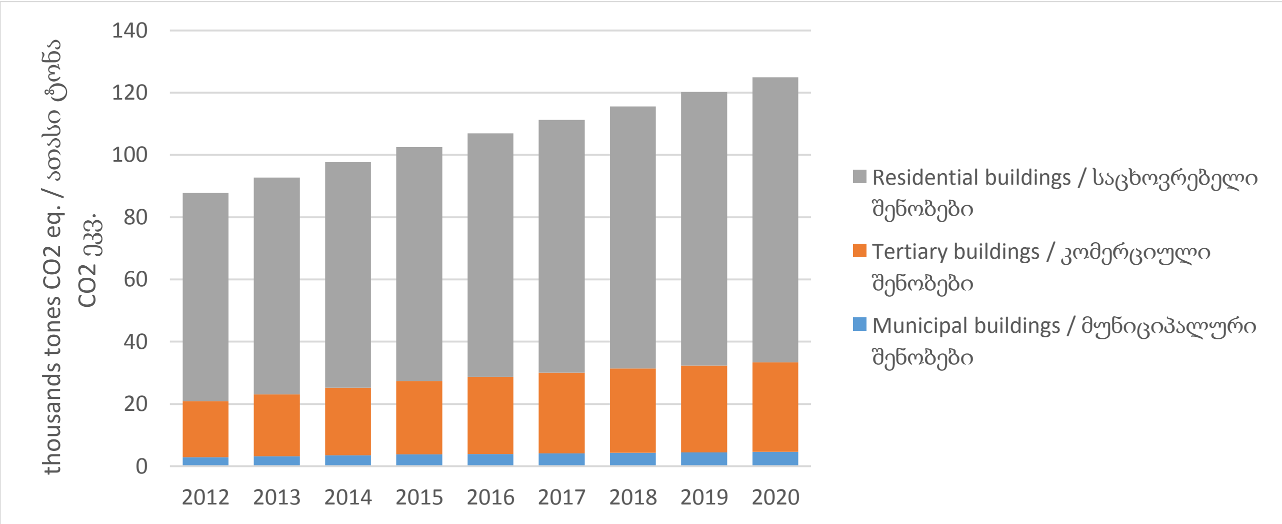


Figure 19. Trends of Emissions from Buildings Sector According to the BAU

GHG EMISSIONS REDUCTION ACTION PLAN FROM BATUMI BUILDINGS SECTOR

A short-term strategy for GHG emissions reduction for the municipal and residential buildings of Batumi presupposes a reduction of consumption through such measures as buildings insulation and using energy efficient bulbs, improved insulation, filling structural gaps, replacing doors and windows, etc which all are relatively affordable measures. These measures must be accompanied by appropriate training and public awareness-raising campaigns.

Another promising way of reducing CO2 emissions is the use of renewable energy. Most energy resources are used for heating and hot water in Batumi, thus biomass, heat pumps and solar energy are potential resources for heating and hot water supply for buildings, and will significantly reduce the amount of natural gas and CO2 emissions.

A long-term strategy for GHG emissions reduction in Batumi might consider manufacturing residual biomass pellets to use in local heating systems. The installation of solar collectors in municipal and residential buildings is potentially an efficient option for this city, where sunny days are above average for the country . Implementing these measures will not only contribute to heating homes and water heating but will support the development of new businesses in renewable energy in the region.

The following measures can be implemented under the short and long-term strategies of Batumi's SEAP:

- Insulate attics and walls in municipal buildings;
- Install energy-saving lighting systems in kindergartens;
- Insulate roofs, windows and walls in kindergartens;
- Use solar collectors in kindergartens;
- Install energy-efficient bulbs in flats of residential buildings;
- Insulate common areas of seven-storey residential blocks;
- Insulate roofs in two-storey private houses;
- Replace windows with double panes in two-storey private houses;
- Develop high-efficiency generators for private homes that use bio waste.

A detailed energy audit was conducted in buildings sector of Batumi on July 15-19, 2014 to determine emission reduction potential through the above-mentioned strategy. Eleven different constructions were selected according to their type of energy consumption. Information and statistical data analysis obtained from this assessment became the basis for determining actual energy-saving potential and development of energy efficient measures in Batumi. This indicates measures to be taken to reduce emissions and improve the deteriorated environmental situation. Following are the photos and names of buildings audited:

Pic. 5. Administrative building of Batumi City Hall. 10, Sulkhan-Saba Orbelianist.

Pic. 6. Batumi kindergarten #8. 4a, Inasaridzest.

Pic. 7. Batumi Public school # 10. 66 I. Javakhishvili st.

Pic. 8. Republican Center of Batumi Maternal and Children Healthcare. 64, Airport Highway

Pic. 9. Private house. 26, I. Javakhishvilist.

Pic. 10. Commercial facility. Market (6, P. Loriast.)

Pic. 11. Commercial facility. Supermarket (8, P. Loriast.)

Pic. 12. Commercial facility. Market (26, I. Javakhishvilist.)


Pic. 13. 2-storey residential house. 6, P. Loriast.

Pic. 14. 3-storey residential block. 8, P. Loria st.

Pic. 15. 4-storey residential block. 12 T. Abuseridze st.

Pic. 16. 5-storey residential block. 4, Inasaridzest.

Pic. 17. 9-storey residential block. 1, Khimshiashvilist.

Pic. 18. 12-storey residential block. 6, Inasaridzest.

Based on extensive studies within the EC-LEDS Project, actual energy savings potential has been determined and estimated through optimal methods of detailed energy audit and appropriate software. The implementation of energy saving measures would save 107,880,926 kWh energy per year, corresponding to 25.00 % of basic energy consumption (423,412,843 kW*h/y). Consequently, CO2 emissions can be reduced by 20,869 tons, or 27.00% of the baseline emissions (78 437 t/y).

Table 37. Energy saving and emissions reduction potential in Batumi by building types

Energy Expenses	**Energy**		**Emissions**		
	Existing	Savings	Norm	Existing	Savings
	kW*h/y	**kW*h/y**	**Kg/kW*h**	**T/Y**	**T/Y**
Energy expenses of private houses					
1. For heating	184,218,284		0.202	37212.09	
Gas	184218284	51913103	0.202		10486.45
Biomass	0	0	0.202		0.00
2. For hot water					
By natural gas	10577905	0	0.202	2136.74	0.00
By electricity	14809067	0	0.136	2014.03	0.00
3. For electrical equipment	30431819	6672217	0.136	0.00	0.00
Total	240037075	58585320		45501.00	11393.00
Energy expenses of kindergartens					
1. For heating	896896	474760	0.202	181.17	95.90
2. For hot water					
By natural gas	55770	0	0.202	11.27	0.00

By electricity	78078	0	0.136	10.62	0.00
3. For electrical equipment	129272	35464	0.136	17.58	4.82
Total	1160016	510224		220.64	100.72
Energy expenses of schools					
1. For heating	2108750	542500	0.202	425.97	109.59
2. For electrical equipment	603750	0	0.136	82.11	0.00
Total	2712500	542500		508.08	109.59

Energy Expenses	Energy		Emission		
	Existing	Savings	Norm	Existing	Savings
	kW*h/y	**kW*h/y**	**Kg/kW*h**	**T/Y**	**T/Y**
Energy expenses of medical institutions					
1. For heating	618800	170170	0.202	125.00	34.37
2. For hot water					
By natural gas	88725	0	0.202	17.92	0.00
By electricity	124215	0	0.136	16.89	0.00
3. For electrical equpment	225680	0	0.136	30.69	0.00
Total	1057420	170170		190.51	34.37
Energy expenses for commercial institutions					
1. For heating	20231265	5430900	0.202	4086.72	1097.04
2. For hot water					
By natural gas	0	0	0.202	0.00	0.00
By electricity	0	0	0.136	0.00	0.00
3. On electric equipment	5205825	335400	0.136	707.99	45.61
Total	25437090	5766300		4794.71	1142.66
Energy expenses for commercial buildings					
1. For heating	1371800	767600	0.202	277.10	155.06
2. For hot water					
By natural gas	61750	0	0.202	12.47	0.00
By electricity	86450	0	0.136	11.76	0.00
3. For electrical equipment	285000	0	0.136	38.76	0.00
Total	1805000	767600		340.09	155.06
Energy expenses of 2-storey buildings					
1. For heating	4132470	1755570	0.202	834.76	354.63
2. For hot water					
By natural gas	338813	0	0.202	68.44	0.00
By electricity	474338	0	0.136	64.51	0.00
3. For electrical equipment	1063350	108420	0.136	144.62	14.75

Total	6008970	1863990		1112.32	369.37

Energy Expenses	**Energy**		**Emission**		
	Existing	Savings	Norm	Existing	Savings
	kW*h/y	**kW*h/y**	**Kg/kW*h**	**T/Y**	**T/Y**
Energy expenses of 3-storey buildings					
1. For heating	3516400	1598900	0.202	710.31	322.98
2. For hot water					
By natural gas	383500	0	0.202	77.47	0.00
By electricity	536900	0	0.136	73.02	0.00
3. For electrical equipment	1103300	241900	0.136	150.05	32.90
Total	5540100	1840800		1010.85	355.88
Energy expenses of 4-storey buildings					
1. For heating	10319400	3913650	0.202	2084.52	790.56
2. For hot water					
By natural gas	1425937.5	0	0.202	288.04	0.00
By electricity	1996312.5	0	0.136	271.50	0.00
3. For electrical equipment	4475250	912600	0.136	608.63	124.11
Total	18216900	4826250		3252.69	914.67
Energy expenses of 5-storey buildings					
1. For heating	32109840	13330800	0.202	6486.19	2692.82
2. On hot water					
By natural gas	3767400	0	0.202	761.01	0.00
By electricity	5274360	0	0.136	717.31	0.00
3. For electrical equipment	13562640	2376360	0.136	1844.52	323.18
Total	54714240	15707160		9809.03	3016.01
Energy expenses of 9-storey buildings					
1. For heating	26195496	10773954	0.202	5291.49	2176.34
2. For hot water					
By natural gas	2875402	0	0.202	580.83	0.00
By electricity	4025562	0	0.136	547.48	0.00
3. For electrical equipment	16477812	2887138	0.136	2240.98	392.65
Total	49574272	13661092		8660.78	2568.99

Energy Expenses	**Energy**		**Emission**		
	Existing	Savings	Norm	Existing	Savings
	kW*h/y	**kW*h/y**	**Kg/kW*h**	**T/Y**	**T/Y**
Energy expenses of 12-storey buildings					
1. For heating	9336160	3224140	0.202	1885.90	651.28

2. For hot water					
By natural gas	1326908	0	0.202	268.04	0.00
By electricity	1857672	0	0.136	252.64	0.00
3. For electrical equipment	4628520	415380	0.136	629.48	56.49
Total	17 149 260	3 639 520		3 036.06	707.77

Table 38. Energy savings and emissions reduction potential by buildings in Batumi

№	Unit	Energy Types	Energy			Emission				Implemented changes in buildings
			Basic	Savings	Saving	Norm	Basic	Savings	Savings	
			kW*h/y	kW*h/y	%	Kg/kW*h	**T/Y**	**T/Y**	%	%
1	2-storey building	Gas	80 264	29 904	–	0.202	16.21	6.04	37.26	a) Ceiling insulation
		Electricity	25 530	992	–	0.136	3.47	0.13	3.89	b) Windows
		Total	**105 794**	**30 896**	**29.20**	–	**19.69**	**6.18**	**31.37**	c) Lighting system
2	3-storey building	Gas	200 715	81 462	–	0.202	40.54	16.46	40.59	a) Ceiling insulation
		Electricity	78 085	6 186	–	0.136	10.62	0.84	7.92	b) Windows
		Total	**278 800**	**87 648**	**31.44**	–	**51.16**	**17.30**	**33.81**	c) Lighting system
3	4-storey building	Gas	116 942	39 696	–	0.202	23.62	8.02	33.95	a) Ceiling insulation
		Electricity	59 473	4 740	–	0.136	8.09	0.64	7.97	b) Windows
		Total	**176 415**	**44 436**	**25.19**	–	**31.71**	**8.66**	**27.32**	c) Lighting system
4	5-storey building	Gas	350 491	128 899	–	0.202	70.80	26.04	36.78	a) Ceiling insulation
		Electricity	169 159	12 581	–	0.136	23.01	1.71	7.44	b) Windows
		Total	**519 650**	**141 480**	**27.23**	–	**93.80**	**27.75**	**29.58**	c) Lighting system
5	9-storey building	Gas	468 401	175 072	–	0.202	94.62	35.36	37.38	a) Ceiling insulation
		Electricity	300 549	25 738	–	0.136	40.87	3.50	8.56	b) Windows
		Total	**768 950**	**200 810**	**26.11**	–	**135.49**	**38.86**	**28.68**	c) Lighting system
6	12-storey building	Gas	240 632	73 180	–	0.202	48.61	14.78	30.41	a) Ceiling insulation
		Electricity	133 936	10 146	–	0.136	18.22	1.38	7.58	b) Windows
		Total	**374 568**	**83 326**	**22.25**	–	**66.82**	**16.16**	**24.19**	c) Lighting system
7	Kindergarten	Gas	139 626	71 808	–	0.202	28.20	14.51	51.43	a)Ceiling insulation
		Electricity	30 520	2 895	–	0.136	4.15	0.39	9.49	b)Lighting system
		Total	**170 146**	**74 703**	**43.91**	–	**32.36**	**14.90**	**46.05**	c) Wall
8	School	Gas	85 347	21 896	–	0.202	17.24	4.42	25.66	a) Ceiling insulation
		Electricity	24 599		–	0.136	3.35	0.00	0.00	
		Total	**109 946**	**21 896**	**19.92**	–	**20.59**	**4.42**	**21.49**	

9	Medical Institution	Gas	281 624	67 430	–	0.202	56.89	13.62	23.94	ა) Ceiling insulation
		Electricity	139 375		–	0.136	18.96	0.00	0.00	
		Total	**420 999**	**67 430**	**16.02**	**–**	**75.84**	**13.62**	**17.96**	
10	Individual private house	Gas	31 135	8 806	–	0.202	6.29	1.78	28.28	a) Ceiling insulation
		Electricity	7 237	590	–	0.136	0.98	0.08	8.15	b) Windows
		Total	**38 372**	**9 396**	**24.49**	**–**	**7.27**	**1.86**	**25.56**	c) Lighting system
11	City hall	Gas	62 277	33 354	–	0.202	12.58	6.74	53.56	a) Ceiling insulation
		Electricity	16 155		–	0.136	2.20	0.00	0.00	b) Wall
		Total	**78 432**	**33 354**	**42.53**	**–**	**14.78**	**6.74**	**45.59**	

Table 39. Emissions Reduction Action Plan for Batumi Buildings

Sectors and Activities	Key Measures in Activities	Responsible Department, Person or a Company (If a third party is involved)	Implementation Period (Start and End Date)	Expected Energy Savings from each Measure (MWh/y)	Expected CO2 (T/y) Reduction from each Measure	Cost of Measures (GEL)
Municipal Buildings (MB)						
Activity MB1	**Improve insulation in municipal buildings**					
MB 1.1	Thermal insulation of ceilings and walls in municipal buildings (10Sulkhan-Saba Orbelianist.)	Economic Policy Agency of Batumi City Hall	2015	33.35	6.8	24 060
Activity MB 2	**Install efficient lighting systems in municipal buildings**					
MB 2.1	Energy-efficient bulbs- based lighting systems in kindergartens	Economic Policy Agency of Batumi City Hall	2015	8.7	1.17	720
Activity MB 3	**Renovate municipal buildings**					
MB 3.1	Insulate roofs and walls in kindergartens	Economic Policy Agency of Batumi City Hall	2015-2018	71.0	72.0	174 340
Activity MB 4	**Consumption of renewable energy resources for hot water supply**					
MB 4.1	Use solar collectors in kindergartens	Economic Policy Agency of Batumi	2015-2020	75.0	15.27	46 800

		City Hall				
Activity MB 5	**Public awareness raising/ information campaigns**	Economic Policy Agency of Batumi City Hall	2012-2020			
Activity MB 6	**Implement energy management & monitoring program in municipal buildings**		2012-2020			
MB 6.1	Control energy consumption, behavioral norms development and raise awareness	Economic Policy Agency of Batumi City Hall				
MB 6.2	Develop Energy database for municipal buildings	Economic Policy Agency of Batumi City Hall				
MB 6.3	Identify energy efficiency indicators to prepare tender documentation necessary for state procurement of rehabilitation works	Economic Policy Agency of Batumi City Hall				
Residential Buildings (RB)						
Activity RB 1	**Installation of efficient lighting systems**					
RB 1.1	Install one energy-efficient bulb in each flat of 7 residential buildings	Economic Policy Agency of Batumi City Hall	2015-2017	82.7	11.2	3 024
Activity RB 2	**Residential Buildings Renewal**					
RB 2.1	Install Thermal insulation in common areas of residential building entrances	Economic Policy Agency of Batumi City Hall	2015	46.6	9.4	14 490
RB 2.2	Install Thermal insulation for roofs in two-storey typical private houses	Investor	2014-2020	5.3	1.1	1 800
RB 2.3	Replace existing windows in two-storey private houses with double glazed windows	Investor	2015-2020	3.5	0.7	2 250
Activity RB 3	**Utilization of renewable sources for hot water supply**					

RB 3.1	Develop bio waste operating high efficiency generators for typical two-storey private houses	Economic Policy Agency of Batumi City Hall	2015	100 090	20 230	2 040 000
Activity RB 4	**Public awareness raising/ information campaigns**					
RB 4.1	Trainings about energy efficiency issues in the buildings for target groups	Economic Policy Agency of Batumi City Hall				
RB 4.2	Carry out mass media and energy efficiency information campaigns	Economic Policy Agency of Batumi City Hall				
Total				**100 416**	**20 348**	**2 307 484**

DETAILED DESCRIPTION OF MEASURES

Measure MB 1.1. Thermal insulation of ceilings and walls in municipal buildings (10, Sulkhan-Saba Orbeliani St.)

Given the resources available, a combination of insulation measures are planned for six municipal buildings. This will include improving thermal insulation of external walls and ceilings of New City Hall at 10, Sulkhan-Saba Orbelianist with an expected energy savings of 21, 590 kWh for the external walls and 11,764 kWh and for ceilings. CO_2 emissions reductions from the building will be 4.4 and 2.4 t/y respectively.

If natural gas is used for heating the annual debit will be 21,590/(8 x 0.9)=2 999 m³/y. Total annual expenditures will reach 2999 x 0.75=2 249 Gel. Investments for thermal insulation of walls is 519 x 40= 20,760 Gel. In case natural gas is used as fuel, its annual expenditure will be 11,764/(8*0.9)=1633 m³/y. Total annual spending, taking gas prices into consideration, will be 1633 x 0.75=1225 Gel. Investments required for the thermal insulation of ceilings are 275 x 12=3 300 GEL.

The profitability parameters of Measure MB 1.1 are presented below.

Table 40. Profitability parameters of Measure MB 1.1

Measure	Investment Cost GEL	Payback	Internal Rate of Return *IRR,%	Net Present Value Quotient *NPVQ	CO_2– reduction T/Y
Thermal insulation of walls	20 760	9.2	10%	0.18	4.4
Thermal insulation of ceilings	3 300	2.7	37%	3.04	2.4
Total	24 060	6.9			6.8

**PB – Payback; *IRR – Internal Rate of Return *NPVQ - Net Present Value Quotient*

Measure MB 2.1. Fluorescent lighting systems in kindergartens

Energy-saving potential has been determined by comparing incandescent lighting systems with energy-efficient bulbs. The basic energy consumption of incandescent lights in the kindergarten located at 4a, Inasaridze St. is 12,913 kWh/y. After taking this measure, the building's energy savings will reach 2895 kWh/y or 2895 x 0.16=463 Gel. Investments for this measure include buying lights: 30 x 8=240 Gel (1 bulb – 8 Gel). An economic profitability analysis is given below. CO_2 emissions reductions will be 2895 x 0.136= 0.39 t/y. Profitability parameters of Measure MB2.1 are presented in the following table.

Table 41. Profitability parameters of Measure MB 2.1

Measure	Investment Cost GEL	Payback	Internal Rate of Return *IRR,%	Net Present Value Quotient *NPVQ	CO_2– reduction T/Y
Energy efficient lighting systems in one kindergarten	240	0.5	191%	6.59	0.39
Energy efficient lighting systems in three kindergartens	720	0.5	191%	6.59	1.17

Measure MB 3.1. - Thermal insulation of a roof and walls in a kindergarten at 4a, Inasaridze St.)

Energy savings resulting from the measure is calculated via the ENSI software, according to which the solution will save 48,285 kW/h for external walls and 23,523 kWh for the ceiling of the kindergarten. Reduction of CO_2 emissions from walls amount to - 48 285 x 0.202= 9.7 t/y and from ceiling23 523 x 0.202= 4.7 t/y.

If natural gas is used as a source of fuel, annual consumption will be 48,285/(8 x 0.9)=6 706 m^3/y. Total annual spending will reach 6706 x 0.75=5029 GEL. Necessary investments for thermal insulation of walls is 704 x 40= 28,160 GEL.

Using natural gas as a source of fuel, annual consumption will be 23,523/(8 x 0.9)=3 267m^3/y. Total annual expenditures after consideration of gas prices will reach 3267 x 0.75=2 450 GEL. Necessary investments for thermal insulation of the ceiling is 559 x 12=6708 GEL.

Profitability parameters of Measure MB3. are presented in Table below.

Table 42. Profitability parameters of Measure MB 3.1

Measure	Investment Cost GEL	Payback	Internal Rate of Return* IRR,%	Net Present Value Quotient* NPVQ	CO_2– reduction T/Y
Insulation of walls per kindergarten	28 160	5.6	18%	0.95	9.7
Thermal insulation of roof per kindergarten	6 708	2.7	37%	2.99	4.7
Total per kindergarten	34 868	4.7			14.4
For 5 kindergartens	174 340				72

Measure MB 4.1. Utilization of Solar Collectors in Kindergartens

Solar collectors convert radiation into heat energy and then heat water for the buildings. This measure aims to use solar collectors to heat water in municipal buildings such as kindergartens. About 4000 liters of hot water per day is consumed in Batumi kindergartens, requiring 24,907 kWh of energy per year.

Solar energy received on the horizontal surface in Batumi is approximately 1200 kWh per year. The surface of the collector can be oriented at a 90-degree angle, which increases solar radiation by 25%, amounting to 1500 kWh/m^2/y. Since solar energy collector efficiency is 70%, 1050 kWh/m^2 energy would be available. If solar collectors are installed on roofs, we will get 25,200 kWh energy from a 24 m^2 total area per year. The standard collector surface is 2m^2 and costs 1300 Gel with installation. Twelve of these are needed for kindergartens at a total investment of 15,600 Gel.

For the same amount of energy from natural gas, 25 200 /8.00 =3 150 m^3, or 3 150 x 0.75=2 362 Gel would be required. Reduction of CO_2 emissions, in case of conversion from natural gas to solar energy, will be 5.09 per year. The profitability parameters of this measure are given below.

Table 43. Profitability parameters of Measure MB 4.1

Measure	Investment Cost GEL	Payback	Internal Rate of Return * IRR,%	Net Present Value Quotient * NPVQ	CO_2 reduction T/Y
Hot water supply through solar energy per kindergarten	15 600	6.60	14.00	0.45	5.09
3 kindergartens	46 800	6.60	14.00	0.45	15.27

Measure RB 1.1. – Install one energy-efficient bulb in each flat of 7 residential buildings

This measure aims to distribute one energy efficient bulb to each family in the pilot apartment buildings (seven 9-floor buildings) on condition that in each family the new bulb will be used in the room where light is most often used or where the family spends most of their time.

The measure must be accompanied by information to the residents of the pilot buildings about the characteristics and economic and environmental benefits of energy efficient light bulbs. This measure will be taken in the same apartment blocks where entrance doors will be replaced.

To calculate the number of flats in an average residential block, an example of a 9-storey, standard, two-entrance apartment building is used with 9 x 3 x 2 = 54 apartments, thus 54 energy efficient light bulbs will be distributed in each building.

Assuming that the annual energy consumption of incandescent lighting is 365 x 10 x 0.1= 365 kW/h, its replacement with fluorescent bulbs that consume 146 kW/h energy will save 365-146= 219 kWh or 219 x 0.16 = 35 Gel per bulb. The total number of lights replaced in a building equals 54, i.e. calculated energy savings will be 54 x 219 =11,826; financial investment is 54 x 8=432 Gel.

The measure is intended for 7 analogous blocks which will total 11 826 x 7=82 782 kWh reduced consumption while requiring an investment of 432 x 7=3024 Gel. Reduction of CO_2 emissions in seven residential buildings will reach 11.2 t/y. Profitability parameters of the measure are given below.

Table 44. Profitability parameters of Measure RB 1.1

Measure	Investment Cost (GEL)	Payback PB	Internal Rate of Return (IRR)	Net Present Value Quotient * NPVQ	CO_2 Reduction t/y
Fluorescent lighting in 7 residential builidngs	3024	0.2	438%	16.35	11.2

Measure RB 2.1.- Heat Common Spaces in 7 nine-storey residential buildings

The measure involves replacing windows with double metal-plastic windows on each floor which will save up to 1260 x 37=46.6MWh energy. Corresponding natural gas savings are about 46 600/(8.00x0.9)=6472 m^3 and emissions reductions equal 9.4 t/y or 36,472 x 0.45 = 2912 Gel per year. The total investment for installing 9 x 2 x 7 x 1=126 m2 metal-plastic windows equals 115 Gel/ m^2x126 m^2 =14,490 GEL. Profitability parameters of the measure are presented below.

Table 45. Profitability parameters of Measure RB 2.1

Measure	Investment Cost (GEL)	Payback PB	Internal Rate of Return (IRR)	Net Present Value Quotient *NPVQ	CO_2– Reduction t/y
Heating Common Areas of Residential Buildings	14,490	5	20%	1.07	9.4

Measure RB 2.2.- Thermal insulation for roofs in two-storey private houses

Additional thermal insulation of the roofs of private homes to raise the thermal resistance coefficient from R=0.51 m^2deg/W to R=2.30 m^2deg/W will save up to 5298 kWh energy, lowering CO_2 emissions by 1.07 t/y, or 5 298 x 0.062 =328 Gel per year. Investment and installation costs are 15 Gel m2 and total investments will be 150 m^2 x 12.00 Gel/m^2 = 1800 Gel. The profitability parameters of the measure are given in Table 7).

Table 46. Profitability parameters of Measure RB 2.2 measure

Measure	Investment Cost (GEL)	Payback PB	Internal Rate of Return (IRR)	Net Present Value Quotient *NPVQ	CO_2– Reduction t/y
Insulation of roofs in typical private house with ceiling area of 150 m^2	1800	5.5	18.2%	1.00	1.07

Measure RB 2.3. – Replace windows by metal-plastic ones in two-storey private houses

This measure will raise thermal resistance coefficient from R=0.17 m^2deg/W to R=0.30 m^2deg/W saving up to 3 508 kWh energy in a typical house resulting CO_2 emissions reduction of 0.71 t/y or 3 508 x 0.062 = 217 GEL per year.

About 30 m^2 of metal-plastic windows will be replaced with investment of 75 GEL/m^2 x 30 m^2 = 2 250 GEL. Profitability parameters of the measure are given below (Table 8).

Table 47. Profitability parameters of RB 2.3 measure

Measure	Investment Cost	Payback	Internal Rate of Return	Net Present Value Quotient *NPVQ	CO_2– reduction
Replacement of Windows	2 250	10.2	9%	0.07	0.71

Measure RB 3.1. - Develop a biomass high efficiency heater for private houses

Developing a high-efficiency heater for private houses will help achieve the project's goals with the participation of investors. The results can be applied to residential buildings as well. A pilot project should be launched with the support from investors to determine optimal technical solutions. The annual demand for heating per house is 29,443 kWh/y. CO_2 emissions reductions in case of conversion from natural gas to biomass will be 29 443 x 0.202=5.95 or 5.76 t/y.

This measure implies a 600 Gel investment for an efficient biomass furnace. Annual savings will amount to 29,443 x 0.06 = 1766 Gel per family. Pilot projects results should propably apply to 3400 residential buildings which will significantly reduce total energy consumption in Batumi. Profitability parameters of the measure are given below.

Table 48. Profitability parameters of Measure RB 3.3

Measure	Investment Cost	Payback	Internal Rate of Return	Net Present Value Quotient* NPVQ	CO_2 reduction
Per House	600	0.3	295%	23.77	5.95
3400 Houses	2 040 000	0.3	295%	23.77	20 230

PUBLIC LIGHTING

Overview of the Sector

Batumi is impressive at night, and it is impossible not to be attracted by its beauty. The rhythm of this small city can be felt best at night on the promenade by the sea. In recent years significant resources were spent for lighting all tourist areas as well as noteworthy buildings and new infrastructure sites. Electricity was also used for fountains and traffic lights.

Pic. 19 Batumi at night

In 2012 new territories were added to Batumi thus increasing the demand for street lighting, although there are still many areas where additional lighting is needed.

Table 49. Energy consumption and spending for street lights in Batumi in 2012

Infrastructures	Electricity consumption (kilowatt hours)	Financial expenses (GEL)
Fountains	348 725.24	55 798.86
Traffic lights	38 998.00	6 239.69
Sports Palace	947 584.00	119 305.92
Language tower	200 292.01	32 048.31
Tower fountains	4 743.30	758.96
Advertising monitors	68 371.10	10 939.93
Street lights of Batumi	10 007 413.00	1 601 262.22
Street lights in newly added areas	1 194 531.88	191 134.64
Total	12 810 658.53	2 017 488.53

As shown by the table, in 2012 Batumi consumed 12.8 million kilowatt hours of electricity, at a cost of 2 million Gel.[11] A total of 12,887 lights are used, as described in the following table:

Table 50. Types of bulb and energy consumption

[11] Source: Infrastructure service of Batumi City Hall

Type of bulb	Number of bulbs	Energy consumption per each	Total kilowatt hour
Diode	441.00	0.03	11.85
Economic	22.00	0.02	0.35
Halogen	68.00	0.07	4.76
Metal halogen	566.00	0.06	35.00
Meta halogen	2 313.00	0.16	364.55
Light diode economic	2 082.00	0.00	6.25
Sodium	7 255.00	0.24	1 735.45
Spiral	140.00	0.10	14.00
Complete	12 887.00		2 172.21

Methodology

The methodology is the same as for the buildings and transport sectors.

Inventory of Baseline Year

In 2012 energy consumption of the street lights sector was 12,810,658 kilowatt hours.
In 2012 emissions by street lights was 1959 tons equivalent of CO_2.
In 2012 the average emission of the electricity network - 0.136 tons CO_2/megawatt hour, is taken as the factor of electricity emission.

GHG Emissions for the BAU Scenario (2013-2020)

In the BAU scenario it was assumed that an increase in public lighting will result from the extension of the city, which also depends on the increase of population numbers. Thus, main drive of this sector is population growth.

- The growth of Batumi city population is demonstrated on image 2
- The number of bulbs will be increased in compliance with population growth
- Added bulbs are non effective sodium bulbs
- The factor of the emissions of the electricity network will not be changed

According to the BAU scenario, energy consumption from street lights will be increased in future to attain 14,500 kilowatt hours by 2020, while CO_2 emissions will reach 2.22 thousand tons by 2020.

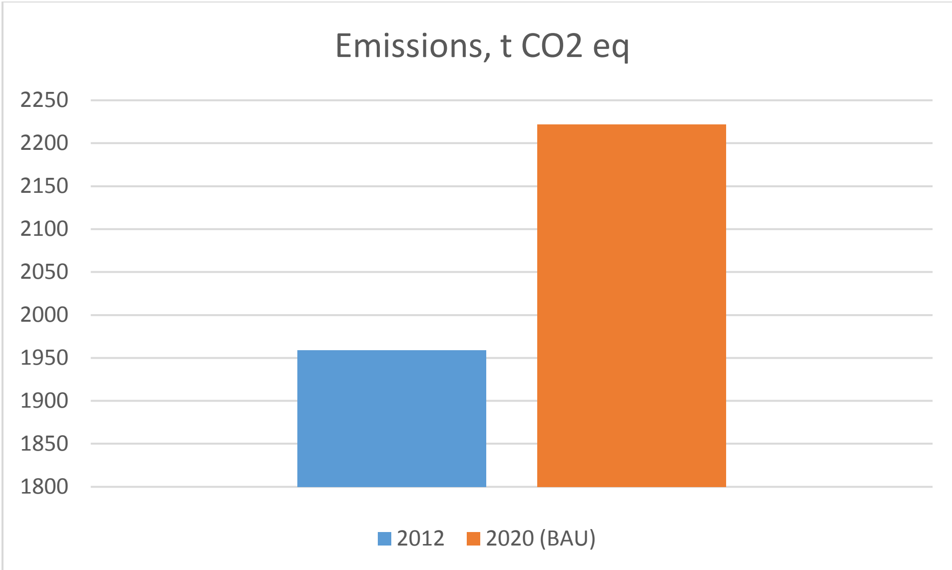


Figure 20. Emissions from the street lights sector in 2012 - 2020

Action Plan for Mitigation of the Emissions from Batumi Public Lighting

The following measures are planned within the action plan for the street lights sector:

- Developing a master plan to audit and create a Batumi street lights system;
- Using modern, effective, energy saving bulbs in street lighting by installing 7300 diode bulbs by 2020;
- Establishing a comprehensive computerized unit for the street lights system;
- Developing software to manage and monitor the street lights system;
- Eliminate energy losses in the street lights system.
- Substituting energy efficient bulbs (e.g. LED) for the present bulbs will have the most significant effect of all activities. Diode light is one of the most efficient modern technologies with the following advantages:
    - Brightness and high level of colors;
    - Waterproof and dust sustainable structure;
    - Rational energy use;
    - Lifespan of LED bulbs is long.

The lifespan of a LED bulb is at least 50,000 hours, while halogen and luminescent bulbs work only 4000 hours. Although an initial investment for LED bulbs is higher, these expenses are offset in the long run. By 2020 65% of lights will be replaced by diode bulbs, totaling 7300 lights. As a result of this activity about 11,300 megawatt hours and 1.7 tons of GHG emissions will be saved. The installation of each bulb costs about 270 Gel which means the total cost of the activity is 2 million Gel. The activity should be implemented gradually over eight years, which means an annual expenditure of 250 thousand Gel.

The diagram below compares the emissions of greenhouse gas for the BAU scenario and the scenario of equipping streetlights with energy efficient bulbs:

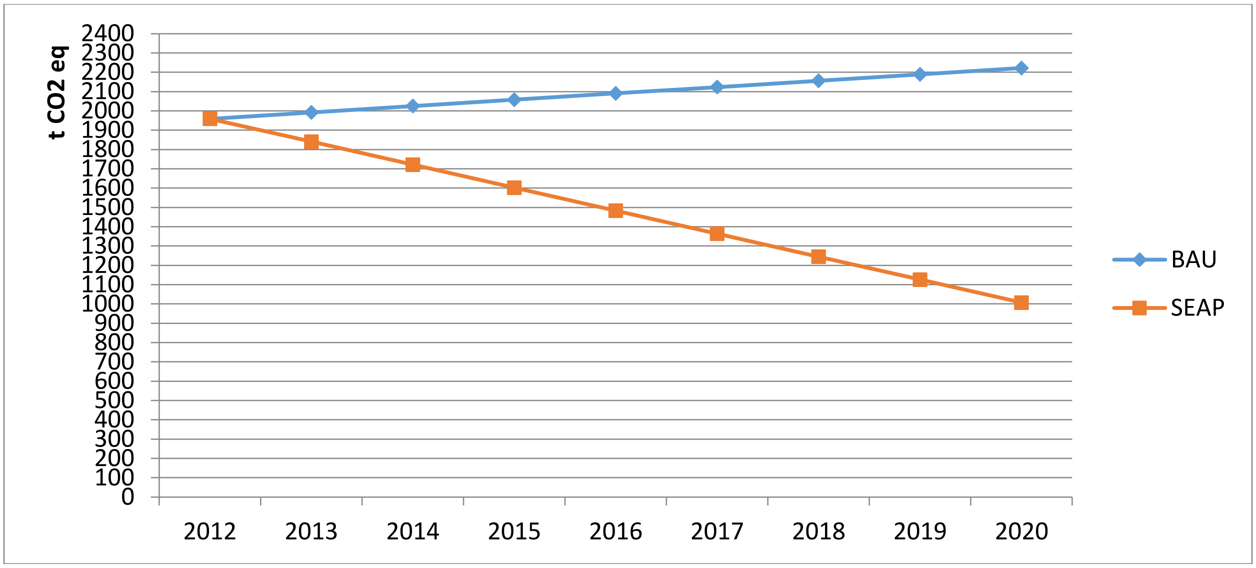


Figure 21. Energy consumption by city streetlights according to the BAU scenario compared to the SEAP activity of light replacement

Other activities mentioned above will also reduce energy consumption and mitigate emissions, but have not been evaluated at this stage.

SOLID WASTE AND WASTEWATER

Overview of the sector

In recent years the construction, tourism and trade boom in Ajara have created favorable conditions for economic growth, and consequently the region is facing the need to transform infrastructures and services to meet the accelerating rate of demand.

Landfills and wastewater are obviously priority spheres in the process. The increasing amounts of municipal, commercial and industrial waste and wastewater require the rehabilitation, re-equipment and modernization of landfills and wastewater purificationfacilities, as well as optimizing management practices. Some first steps have been taken, but this process needs to be hastened to achieve the proper level of services.

Solid waste

The Batumi landfill has operated since 1965 and today is used for dumping waste from residential districts of Batumi and Khelvachauri municipalities.. It occupies 19.2 ha in the Batumi Adlia settlement 300 m from the Batumi Airport and housing of local residents. The landfill also borders a petrol service station and the Duty-free Administration building, the Chorokhi River and the Black Sea. Dominant winds dissipate odors from the landfill towards the seacoast, inconveniencing tourists and residents alike. At the entrance of the landfill there is a control station. One part is allotted to dispose of animal remains (mostly cattle and pigs) yet the landfill has neither waterproofing nor any wastewater treatment or methane gas collection facility. The height of solid waste in some places exceeds 6 meters. In the Soviet period a waste-processing plant was constructed near the highway but it never operated, due to political turmoil in 1989.

Since 1990 the company “Sandasuptaveba Ltd” has registered the waste transported to the landfill. About 700-850 m3 of garbage is delivered daily, amounting to 250 000-300 000 m3 of waste annually. The waste is only rammed on- site, which often causes flaring and fires. Based upon the annual average amounts of waste (254 883 m3), for the period of 1990-2012 (22 years) the total amount can be estimated at 5,607,419 m3. Before 1990 garbage collection in Batumi was not properly organized and daily amounts varied from 400-500 m3, or 165,000 m3 annually. The total volume of accumulated waste in the first period of SWDS operations (1965-1989) was 3,800,000 m3 which meant the total amount of waste at the landfill was 9,407,419 m3.

During handling, waste sanitary and hygienic regulations are ignored and outsiders carry out prohibited activities at the landfill such as collecting scrap metal scrap, glass, and different domestic articles. During 1993-1997 part of the landfill was washed off by flooding from the Chorokhi River, without impacting major dumping area. In 1998-1999 with financial assistance from the World Bank, a flood protection wall was constructed to separate the landfill from the river and the wall partly held up the erosion of the landfill. In 2009 the Ministry of Environment created a 1040 m dam along the Chorokhi to eliminate the risk of erosion from the landfill. In the last two years further consolidation of the bank down to the mouth of the river is planned in connection with the construction of a new bridge over the river. The landfill is located on a complex geological terrain, which hampers wastewater control. The only way to solve this is to close down the landfill and reconstruct the landscape as quickly as possible.

This is why the Ajara Government and Batumi Municipality plan to close down the Batumi landfill in 2015.[12] Instead of this landfill the creation of a new landfill or solid waste disposal site (SWDS) according to EU standards is planned 500m from the village of Tsetskhlauri in the Kobuleti municipality on an abandoned cattle-breeding farm. The design for the construction of new SWDS has been drawn up by the Ajara Ministry of Finance and Economy (Batumi Municipality is represented by the Mayor in the Advisory Committee of the project).

The new SWDS will not receive harmful wastes and will function in accordance with EU directive 1999/31/EC related to the establishment of environmental standards. The new SWDS, in addition to the sanitary landfill, will include facilities such as buildings, weighing bridges, wastewater collectors and a treatment system as well as processing, sorting and storing facilities. A methane recovery system will be able to collect gas after 3-5 years.

After weighing and registering waste and other materials at the entrance, it will be graded and piled according to type and harmful wastes will be sorted placed in special containers outside the territory to transport them to specialized elimination sites. Materials intended for processing mainly include metal, plastics, glass, paper, wood and other economically valuable waste products.

The area of the new landfill occupies 32 ha and is 12 m deep. Total permissible volume of disposed solid waste is 3.4 million m3, which should fill up in 35 years. The area of each cell of SWDS is 10 ha. According to preliminary estimations, the landfill will take 42,000 tons annually (115 tons daily) of domestic waste collected from Batumi and five Ajara municipalities and will gradually increase received waste up to 80,000 tons per annum.

[12]After the 2013 elections, the new government may, presumably, postpone this issue once more, since the new authority has not yet determined the implementation of this project. The revision of all initiated and planned projects is continuing, however, to assess their expediency.

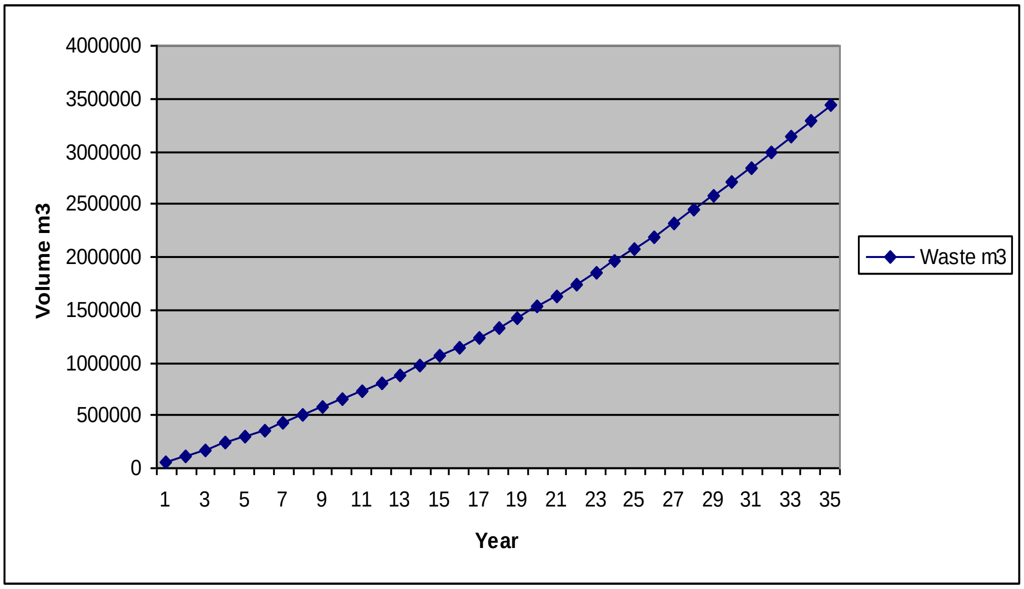


Figure 22. Anticipated trend of waste generation at Ajara's new landfill

The waste will be divided into 10 ha cells to keep an even waste area. Step by step, the interim cover will be laid for pouring off the surface waters and mitigating wastewater origination when waste reaches permissible heights. Covering waste will be performed at three different levels with alternative methods: daily covering, creation of an interim layer and final coverage. Daily covering will be carried out by laying a 5 cm or deeper stratum of soil or other material. This will help decompose organic materials and avoid the risk of pollution by light trash that disperses in the wind, such as plastic and paper.

The interim layer consists of about 50 cm of a waterproof soil stratum that prevents the spread of polluted surface waters from the waste cell. This type of cover is used for surfaces dumped prior to six months. The layer must be put in place before gas wells develop, which makes it possible to use a sub-pressure system for landfill gas extraction system without the intrusion of oxygen into the core of the waste. After completely filling the cell it will be covered by a final layer. Each cell of waste will be gradually filled to the prescribed final level and the surface will have an inclination of no more than 1:3 (vertical: horizontal) to permit optimal working conditions and the possibility to lay the final cover when the landfill is closed. Maximum inclination also prevents risks for erosion. After reaching a maximum height, the slope will slightly incline towards a small ridge in the center of landfill that can accumulate any surface waters. Minimal inclination should be 1:20 to prevent flooding of the territory and surface waters must be able to run off, to avert the waste being washed off and to protect the environment from pollution.

Wastewater

Normally a wastewater purification facility gets waste waters from residential, commercial and sometimes from industrial utilities, which contain many toxins and must be removed before the water is released into a defined area of water catchment, established by a country's legislation order for the protection of ecological safety in rivers, seas and other natural reservoirs. That is the function of water purification facilities which purify wastewater to provide its conformity to required norms. The purification procedures may include mechanical, biological and chemical purification. Mechanical refining ensures the removal of heavy metals and other solid substances from the entering the water system, and the removal of various chemical compounds, especially important when collecting industrial wastewaters, while biological cleaning implies the removal of organic matters from wastewater.

Despite the fact that up to now 137 wastewater units are operating in Ajara with a capacity of 92,849 m3 in virtually districts of the region the purification of wastewater is poorly carried out and increasingly large amounts of harmful compounds drain into reservoirs (rivers and the sea) each year. For example, in 2011, according to official data, 4697 tons of unsafe substances were released into Ajara's reservoirs. Most wastewater purification units do not provide adequate levels of purification. Most painfully, the problem of water cleaning was halted in Batumi, where the Adlia water purification facility, constructed in 1977, was unable to purify the wastewater from the collector. This is practically untouched and now drains into the sea.

After a study carried out in 2008, the Adlia wastewater facility was later rehabilitated and a collector constructed to gather wastewater from all settlements along the coast from Batumi to the border with Turkey and transport it to the Adlia facility. In the project proposal for the rehabilitation of the wastewater purification facility improvements have been studied and the best option selected on the basis of cost-benefit analysis. As a result, in April 2012 the facility began operating and is currently functioning normally. At the same time the rehabilitation of collectors is continuing and should be completed within two years.

The facility can accommodate waste from 200,000 people which is the projected population in 2028, including maximums in summer seasons. The rehabilitated unit performs mechanical and some biological purification functions, so that released water mainly conforms to regulations on the quality of clean water. The design of the unit is not intended for the recovery of methane, however, thus biodegradable matter removed from the water is left to decompose in anaerobic pools. This deposited silt is periodically pumped out and dried at special sites. As a result of this mass, the alluvian materials in the pool sometimes produce "wastewater gas"-methane which dissipates in the atmosphere and contributes to an increase of GHG concentrations. At the same time the odor that accompanies the decomposition process spreads over surrounding territories and intensifies with the growth of the mass.

The main purpose of biological purification of the wastewater purification unit is to remove the methane-generating mass from wastewater. According to international practices the best way to deal with this is to recover the generated methane and use it as energy to produce heat and electricity either at the unit or to the gas network/electricity grid, or else as a transportation fuel. After extracting methane the remaining mass of decomposed silt can be used as a fertilizer in agriculture or forestry, and gardening. Such approaches are environmentally friendly solutions to the problem, beneficial both from the standpoint of climate change and for economic reasons as well.

METHODOLOGY

Solid waste

Landfills produce 3 types of greenhouse gases: methane (CH4), carbon dioxide (CO2) and non-methane volatile organic compounds (NMVOCs). Most GHG generated at the solid waste disposal site (SWDS) is methane. According to IPCC methodology CO2 produced by organic matter is not considered as a pure CO2 emission. There is no methodology to calculate CO2 and NMVOCs emissions.

Methane emissions from Batumi SWDS are calculated using First Order Desay (FOD) method, regarded by the IPCC as a good approximation to identify the main sources of methane emissions. The FOD method implies that: (a) methane from the piled waste is not produced instantly, but is emitted gradually along with the decomposition of masses of waste, and (b) degradation and generation of methane fits the exponential law. The parameter describing the decay period is to be selected taking into account specific conditions of the country and the composition of the waste.

According to this methodology methane emissions from the landfill are calculated using this formula:

Tier 2: First Order Decay (DOC)method

$$M^G_{CH4}(t) = \sum_{x=1}^{x=t}[(A \bullet k \bullet MSW_T(x) \bullet MSW_F(x) \bullet MCF(x) \bullet DOC(x) \bullet DOC_F(x) \bullet F \bullet 16/12)] \bullet e^{-k(t-x)},$$

$$M^E_{CH4}(t) = [M^G_{CH4}(t) - R(t)] \bullet (1 - OX), \qquad (2)$$

There:

$M^G_{CH4}(t)$ = Methane generated in year t, ***$M^E_{CH4}(t)$***Methane finally emitted to the atmosphere;

MSW_T =Pop • GR.

Pop =Number of population which MSW is desposed at the landfills;

GR =Per capita waste consumption;

$MSW_T(x)$-Total municipal solid waste (MSW) generated in year x (Gg/yr)

***MSW_F* (x)**= Fraction of MSW disposed at SWDS in year x;

MCF (x)= Methane correction factor in year x (fraction);

***DOC* (x)** = Degradable organic carbon (DOC) in year x (fraction) (Gg C/Gg waste);

DOC_F = Fraction of DOC dissimilated;

F = Fraction by volume of CH4 in landfill gas;

R (t) = Recovered CH4 in inventory year t (Gg/yr);

OX= Oxidation factor (fraction);

t = year of inventory;

x = years for which input data should be added;

$k=ln(2)/t_{1/2}$ - Methane generation rate constant; $t_{1/2}$ - decay to half its initial mass;

$A=(1-e^{-k})/k$ - normalisation factor which corrects the summation;

Emissions were calculated according to the amount of the actual waste piles. Values of other factors were taken as follows:

- Methane emission correction factor (MCF): 0.8;
- Degradable organic carbon (DOC): DOC default values according to waste composition;
- The degraded part of DOC - 0.5;
- Share of methane in landfill gas (F) - 50%;
- Oxidation index (OX) - 0.

Values of remaining factors were taken as default values for similar to Ajara conditions , recommended in the IPCC Methodology.

Wastewater

The amount of "recovered" methane was calculated as the difference between amounts of methane emitted in case of project implementation and in case if it is not implemented.

Baseline emissions for 2014-2018 have been calculated according to actually measured activity data and based upon following assumption: 1) All sewage water collectors will become operational in 2016 (the complete rehabilitation of collectors will be over) and 2) wastewater purification facility will increase its load up to 200,000 (today loading is about 80% of that) to 2028. To provide the collector system to the growing population, the load was extrapolated between 2014 and 2028. The amount of emitted methane was estimated according to IPCC Methodology for the calculation of methane emissions from wastewater (Tier 1), recommended by UNFCCC Parties in preparing the GHG National Inventories (IPCC Revised 1996 Guidelines for National GHG Inventories, reference manual, vol.6; IPCC Good Practice Guidance, Ch.5).

The method recommends a formula to calculate methane emissions that takes into account degradable organic matter contained in the given amount of wastewater as an activity data and emissions factor. The amount of "recovered «methane is subtracted from emitted methane:

Emissions = (Total Organic Waste xEmission Factor) – Methane Recovery

The first part of this formula implies amount of emitted methane from certain treatment system before its recovery. For the calculation of "saved" emissions or reduced as a result of project activity, the difference between the amount of degradable matter and the amount of degradable matter in wastewater flowing into and discharging out of anaerobic pools (serving as disaster units) is used. This value corresponds to the degradable mass remaining in the pool. Default emission factors selected according to local conditions were used as well.
In particular:
_ The amount of degradable matter is described by BOD (Biochemical Oxygen Demand) (5 day measurement method is used, called BOD5) measured at the entry and outlet of anaerobic pools at the purification facility. This factor is measured both in concentration (mg/l) and in total capacity (kg). The difference between the amounts of degradable matter at the entry and outlet gives the amount of degradable matter, from which "saved" or "recovered" methane is calculated using appropriate indices.
_ The values of maximum potential for methane transformation (Bo) is taken equal to 0.6 (KgCH4/kg BOD);
_ The methane correction factor (MCF) characterizes the part of degradable matter (BOD) which is transformed into methane, or what part of Bo is realized in given conditions. This factor takes on maximum value during the anaerobic controlled processing and is equal to zero in completely aerobic conditions. Ensuing from local terms and according to IPCC-2006 recommendations the value of 0.8 was chosen for open anaerobic pools and 1.0 after they are covered. (Table 6.3, Chapter 6, vol. 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories)

Baseline year inventory and GHG emissions baseline scenario (2012-2020)

Solid waste

According to the result of GHG inventory carried out in the framework of Georgia's First National Communication to the UNFCCC, using the FOD Tier 2 method means that in 2011 from the Batumi SWDS 0.71Gg of methane were emitted, or 14,910 tons in CO2 equivalent.

Corresponding to the BAU scenario in 2015 the Batumi SWDS will be closed down and methane emissions will start to decrease. Table 51 shows the forecast for the methane emissions slow-down from Batumi closed SWDS.

Table 51 Methane annual production from Batumi old SWDS after its closure

Year	Gg/yr	Kg/yr	M3/yr	M3/day
2014	0.67	665 476.00	924 272.20	2 532.25
2015	0.58	576 745.40	801 035.30	2 194.62
2016	0.50	501 650.20	696 736.40	1 908.87
2017	0.44	437 965.30	608 285.10	1 666.53
2018	0.38	383 836.90	533 106.70	1 460.57
2019	0.34	337 720.00	469 055.50	1 285.08
2020	0.30	298 326.60	414 342.50	1 135.18
2021	0.26	264 582.50	367 475.70	1 006.78
2022	0.24	235 591.30	327 210.10	896.47
2023	0.21	210 604.70	292 506.50	801.39
2024	0.19	188 997.60	262 496.70	719.17
2025	0.17	170 247.60	236 455.00	647.82
2026	0.15	153 917.70	213 774.50	585.68
2027	0.14	139 641.90	193 947.10	531.36
2028	0.13	127 113.80	176 546.90	483.69
2029	0.12	116 076.20	161 216.90	441.69
2030	0.11	106 313.30	147 657.40	404.54

To replace this, a new SWDS will be opened. Predicted emissions in case of a constant amount of dumped waste (42 000 ton/yr), are presented on the following Table.

Table 52.Methane generation from new SWDS in case of constant annual piling of residential waste amounting to 42 000 ton/yr

Year	Gg/yr	Kg/yr	M3/yr	Year	Gg/yr	Kg/yr	M3/yr
2014	0.00	0.00	0.00	2032	1.82	1 815 507.00	2 521 538.00
2015	0.27	270 361.90	375 502.70	2033	1.84	1 839 964.00	2 555 505.00
2016	0.50	500 378.10	694 969.60	2034	1.86	1 862 132.00	2 586 295.00
2017	0.70	696 557.60	967 441.10	2035	1.88	1 882 295.00	2 614 299.00
2018	0.86	864 327.50	1 200 455.00	2036	1.90	1 900 692.00	2 639 850.00
2019	1.01	1 008 215.00	1 400 299.00	2037	1.92	1 917 528.00	2 663 234.00
2020	1.13	1 131 999.00	1 572 221.00	2038	1.93	1 932 980.00	2 684 694.00
2021	1.24	1 238 834.00	1 720 603.00	2039	1.95	1 947 198.00	2 704 442.00
2022	1.33	1 331 356.00	1 849 105.00	2040	1.96	1 960 313.00	2 722 657.00
2023	1.41	1 411 768.00	1 960 789.00	2041	1.97	1 972 437.00	2 739 496.00
2024	1.48	1 481 915.00	2 058 216.00	2042	1.98	1 983 670.00	2 755 097.00
2025	1.54	1 543 341.00	2 143 529.00	2043	1.99	1 994 095.00	2 769 576.00
2026	1.60	1 597 340.00	2 218 528.00	2044	2.00	2 003 788.00	2 783 039.00
2027	1.64	1 644 998.00	2 284 720.00	2045	2.01	2 012 815.00	2 795 577.00
2028	1.69	1 687 228.00	2 343 372.00	2046	2.02	2 021 233.00	2 807 269.00

2029	1.72	1 724 796.00	2 395 550.00	2047	2.03	2 029 094.00	2 818 187.00
2030	1.76	1 758 349.00	2 442 152.00	2048	2.04	2 036 443.00	2 828 394.00
2031	1.79	1 788 433.00	2 483 934.00	2049	2.04	2 043 321.00	2 837 946.00

Thus, in 2020 methane emissions from both SWDS will make 1.43 Gg each to 30,036.9 tons in CO2 equivalent.

Wastewater

Base year emissions are calculated from 2013 mass of total biodegradable matter, which remained in anaerobic pools (1806.19 ton of BOD) using the following factors: Bo= 0.6, MCF= 0.8, correction factor for industrial inflow current = 1.25 (Chapter 6, vol.5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories), that result in 1354.6 tons of methane emissions annually. This situation will continue in 2014-2015, giving a total of 2709.28 tons of methane through these two years.

From 2016, separately from the project, a total rehabilitation of collectors is planned, which will increase the BOD loading by at least 30%. The gradual extension of sewage collectors to all the population will result in 200,000 reached in 2028, the designed capacity of the project. According to this calculation, in the period of 2016-2028 methane emissions will tend to rise.

If the project begins in 2016 the value of index MCF, featuring the degree of anaerobic treatment, will become equal to 1 which corresponds to the ideal anaerobic conditions in closed anaerobic pools. If 80% is removed (conservative approach), only the remaining 20% will result in emissions. As a result of rehabilitation there will be a sharp reduction of methane emissions in 2016, and in following years the amounts will gradually increase but only according to users of the facilities and utilities. The dynamics of this process are described in the following Table.

Table 53. Baseline emissions of methane (BAU scenario) in 2015-2020 from the Batumi (Adlia) wastewater purification facility

Year	Population connected to the system	Generated methane (ton) baseline BAU	Year	Population connected to the system	Generated methane (ton) baseline BAU
2013	148 000.00	1 083.71	2021	173 782.00	2 067.81
2014	151 000.92[13]	1 105.69	2022	177 305.69	2 109.74
2015	154 062.69	1 128.11	2023	180 900.83	2 152.52
2016	157 186.54	1 870.34	2024	184 568.86	2 196.16
2017	160 373.74	1 908.27	2025	188 311.27	2 240.69
2018	163 625.56	1 946.96	2026	192 129.57	2 286.12
2019	166 943.31	1 986.44	2027	196 025.28	2 332.48
2020	170 328.34	2 026.71	2028	199 999.99	2 379.77
Total	972 520.17	13 056.22	Total	2 465 543.66	17 765.29

[13] Population number is interpolated

Action Plan for the reduction of emissions from Batumi solid waste and wastewater sector

These measures are aimed at the reduction of GHG emissions from the Waste sector:

- Creation of gas extraction system at the Batumi operation landfill
- Creation of methane extraction and *in situ* flaring or utilization system at the new Ajara landfill
- Perfection of biological purification stage at the Batumi wastewater purification system with addition of methane recovery component.

The proximity of the Batumi operation landfill and the wastewater purification facility makes it possible to combine conversion measures by these two utilities. Collected methane could be used to generate electricity or supplied to consumers as a natural gas.

Burying organic or partly organic waste is always followed by decomposition resulting in the emission of GHG, mainly of methane (CH_4) and carbon dioxide (CO_2). In order to reduce the GHG emissions, as it is requested by the UNFCCC, Party to which is Georgia, in many countries methane is being collected and flared, or used as a source of energy (electricity, gas). Otherwise, if methane is not collected, the unpleasant smell spreads over the area and GHGs are emitted into the atmosphere. As a rule, GHGs from organic waste begin a few months after burial and continue for up to 70 years.

The approximate amount of waste accumulated up to now at the Batumi SWDS is about 9,407,419 m^3. According to 1990 Handbook data, 1 m^3 of waste corresponds in mass units to 0.22-0.24 tons. Hence, the total mass of waste at the Batumi landfill can be estimated as 9,407,419 m^3. 0.22 t/m^3=2 069 632 t. In line with the IPCC recommendations, which implies the generation of 100-200m^3 of biogas from 1 ton of waste (depending on its composition and climate conditions), it can be assessed that during the full period of waste decay (70 years), no less than 206,963,200 m^3 of biogas will be emitted to the atmosphere. From this quantity a minimum of 50% is methane which can be used.

Since emissions of GHGs will continue for up to 50 years after the landfill is closed it would be best to create a gas recovery system (gas wells, gas collecting pipes, gas pump station, insulating trap, gas motors and gas flare) to collect the gas and use it however if there is no interested consumer or relevant infrastructure nearby, it is cheaper to burn the gas on site, thus reducing its emissions, eliminating smells and decreasing the risk of spontaneous flares. One of the complications of this project is the correct assessment of daily production of gas that sometimes significantly differs from theoretical calculations. Theoretical calculations show (Annex VII) that for the first 10 years the minimum amount of methane gas, which could be used for energy generation, is 800 m3 per day.

The closing of existing landfill is planned for the end of 2015, immediately after the opening of the new SWDS. According to plans the existing landfill waste will be collected and divided into two piles which cannot erode and rammed to reduce their volume. Then they will be covered a 0.5 m layer of waterproof materials/earth. The upper part of the cover with a 20 cm min drainage stratum and 0.6 m earth layer, should promote vegetation cover.

The total budget of landfill conservation, methane collection and recovery and electricity generation totals 2,544,000 USD. This includes 471,000 USD on expenses for methane collection, flaring at the site and arranging a monitoring system. Depending on the amount of flared gas (a total amount of 109,000 tons in CO2 equivalent) and considering the price of 1 ton of certified CO2 (minimum 5 USD), for 20 years the income generated will total 545,000 USD. Additionally the methane will last longer and provide additional income when registered as a CDM project.

Creating methane extraction and on-site flaring or utilization system at the new Ajara landfill

The primary concept of the new site is based on mounted perforated gas wells on waste piles once the site has been coated with an insulating interim cover. Sub-pressure for gas recovery will be produced at the gas pump-station by wind machines. From the environmental viewpoint, the final result will be burning gas (methane) at the site with CO2 emissions in small quantities. According to local needs, the recovered methane can be used by the local heat supply system or transformed into electricity. In this specific case the gas will probably be supplied to local populations or facilities/enterprises.

According to IPCC recommendations, one ton of waste, depending on its composition and climatic conditions, this generates 100-200 m^3 of biogas. For Batumi the most conservative assumption implies the extraction of 100 m^3 of biogas from a ton of waste. Therefore, during the complete period of waste decay (70 years), 74,800,000 m^3 of biogas will be emitted into the atmosphere from the total amount of dumped waste. From this quantity, at least 50% is methane that can be used for electricity or by consumers as natural gas.

The total budget of the new landfill creation of methane collection and extraction, and a monitoring system totals \$501,000 excluding expenses required for the lay-out of infrastructure for gas delivery to the local population. Tentatively, in 20 years the amount of emissions saved will be 531,900 tons in CO2 equivalent. Accounting for the price of 1 ton of certified CO2eq (minimum 5 USD), in 20 years project will make \$2.7 million, which will exceed by 5.3 times the overall costs for putting it in place. It should be possible to save approximately 15,000 tons of CO2 eq emissions by recovering 50% of methane from both landfill sites by 2020.

Modernizing the Batumi wastewater purification system

This project aims to improve the functioning of the Batumi wastewater purification facility and bring it up to modern standards. It will perfect the biological purification stage by adding methane recovery that will provide better wastewater cleaning and increase the financial expenses on energy consumption while delivering methane gas, and electricity and cleaning up the air and surrounding territories.

This project could make a significant contribution in realizing the Batumi sustainable energy development plan. The additional electricity could be supplied to the grid and in case of methane is used in transport it will replace imported diesel/LPG. The following table shows annual data from 2020 and 2028 for clean energy obtained by using recovered methane from the Batumi water purification facility, of electric energy to the grid and for city transport.

The technical implementation of the project is planned for 2014-2015, when the technical rehabilitation will take place, and activities will continue to 2015-2020 and beyond. Results obtained under the project are calculated to 2020 and 2028 according to the dates agreed under the Covenant of Mayors and from approximated dates according to the purification facility technical documentation (2028).

The following Table presents the Adlia water purification facility modernization plan with budget, where joint utilization activities connected with the old landfill and recovered methane are envisaged (Table 54).

Table 54.Forecast of methane recovery from wastewater and substituted by clean energy

Years	Population connected to system	Generated methane (t) baseline (BAU)	Project activity				
			Methane emissions		Methane savings		
			Methane emission (t CH4)	Methane emission (t CO2e)	t CH4	m3 CH4	MW
2013	148 000.00	1 083.71	1 083.71	22757.96294			
2014	151 000.92[14]	1 105.69	1 105.69	23219.41478			
2015	154 062.69	1 128.11	1 128.11	23690.22324			
2016	157 186.54	1 870.34	374.07	7855.437867	1 496.27	2 086 853.39	21 838.92
2017	160 373.74	1 908.27	381.65	8014.718653	1 526.61	2 129 167.47	22 281.74
2018	163 625.56	1 946.96	389.39	8177.229096	1 557.57	2 172 339.54	22 733.53
2019	166 943.31	1 986.44	397.29	8343.034681	1 589.15	2 216 386.98	23 194.49
2020	170 328.34	2 026.71	405.34	8512.202224	1 621.37	2 261 327.55	23 664.79
Total 2015-2020	972 520.17	13 056.22	5 265.25	110 570.22	7 790.98	10 866 074.92	113 713.47
2021	173 782.00	2 067.81	413.56	8 684.80	1 654.25	2 307 179.36	24 144.63
2022	177 305.69	2 109.74	421.95	8 860.90	1 687.79	2 353 960.88	24 634.20
2023	180 900.83	2 152.52	430.50	9 040.57	1 722.01	2 401 690.97	25 133.70
2024	184 568.86	2 196.16	439.23	9 223.88	1 756.93	2 450 388.85	25 643.32
2025	188 311.27	2 240.69	448.14	9 410.90	1 792.55	2 500 074.16	26 163.28
2026	192 129.57	2 286.12	457.22	9 601.72	1 828.90	2 550 766.92	26 693.78
2027	196 025.28	2 332.48	466.50	9 796.41	1 865.98	2 602 487.54	27 235.03
2028	199 999.99	2 379.77	475.95	9 995.05	1 903.82	2 655 256.88	27 787.26
Total 2015-2028		28 632.12	6 628.91	139 207.08	22 003.21	30 687 880.48	321 148.67

[14]Number of people is interpolated.

Table 55.Implementation stages and budget for the Adlia wastewater purification facility modernization project

No	Activity	Implementing agency	Budget (EUR)	Implementation dates
I	Selection of machinery, purchase and installation			
1	Selection of equipment (pool covering membrane, heat generator, methane tank, pipes, etc) according to local features.		5 000 EUR	2014
2	Purchase of pool covering membrane		375 000 EUR = (22320 m2+25000 მ2)* 15 EUR /m2)	2014–2015
3	Purchase of heat generator		180 000 EUR.	2014–2015
4	Purchase of methane tank		100 000 EUR.	2014–2015
5	Mounting of the equipment		10 000 EUR.	2014 – 2015
6	Arrangement, purchase, construction and preparation of buildings and control systems		150 000 EUR.	2014–2015
7	Other expences		80 000 EUR.	
8	Total : 1+2+3+4+5+6		700 000 EUR.	
II	Assessment of possibilities for recovered methane selling			
1	Connected of obtained landfill gas to the network (opt.1)		100 000 EUR.	2015
2	Selling of methane as transport fuel (opt.2)			2015
III	Permanent monitoring and measuring of the functioning of installed equipment and methane emission and recovery			2015–2028
	Total I+ II+ III		800 000 EUR.	

Methane recovered as a result of the wastewater purification facility project implementation will be added to the amount of gas extracted from the old landfill disposed near the Adlia purification facility. Annual quantities recovered from the old landfill, according to a 2020 conservative assessment would be 150 tons added to those recovered from the Adlia water purification unit – 6 142 tons (see Table 55) . The amounts could actually be twice these figures. Eventually, both units annually could contribute 6292 tons of methane or 132,117 tons in CO_2 equivalent.

Option 1. If electricity is generated from the recovered methane, it would be possible to get 1,922,000 m3 * 10.4 KWh * 0.3= 5996 640 KWh of electricity. In 2012 the outdoor lighting system in Batumi consumed 10 million KWh of energy, thus it would be possible to provide 50% of street lighting in the city by energy produced by collected methane.

Option 2. From 1383.7 tons of methane it is possible to produce 1.5 million m3 of compressed natural gas, enough to operate 36 municipal buses annually (with their total annual run of 103,680 Km and compressed natural gas consumption of 40 m3 per 100 Km run).

As the compression of 1384 tons of methane results in the emission of 1384 * 2.75 =3806 tons of CO2, each year it would be possible to avoid 29,058 – 3806 = 25,252 tons of CO2 emissions, which covers 4.3% of planned to 2020 reductions, while due to the reduced consumption of diesel fuel by Batumi buses, the annual emissions will be additionally reduced by 70 tons of CO2.

For Batumi, which is one of the principal tourist centers in Georgia, the implementation of all three measures are priorities. This will permit the city to maintain its high quality of tourism as well as good living conditions for locals.

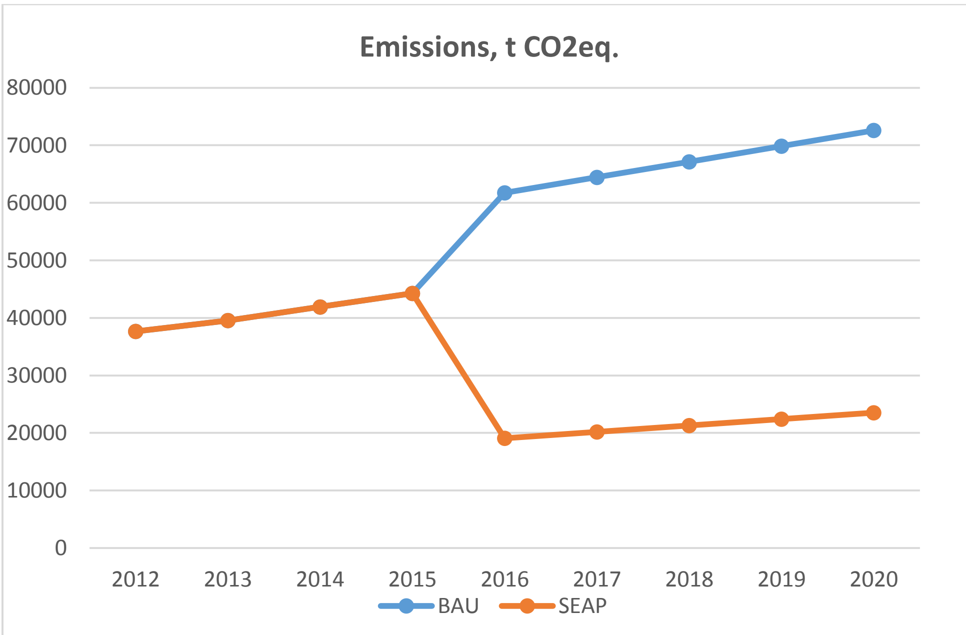


Figure 23. Comparison of methane emissions from the Waste sector for BAU scenario and in case the project is implemented

GREENING

Overview of the sector

Batumi's ecological condition has deteriorated significantly over the recent years largely due to the decreases of green cover, which began in the 1990s. The reconstruction of the city center in recent years and chopping down trees has further worsened the picture. The city center has become congested by traffic, which again deteriorates the overall ecological conditions of the city. When reviewing the city's environmental problems it is pertinent to determine the scale of carbon accumulation by plants after greenery works begin and to calculate the carbon dioxide - greenhouse gas absorption capacity by the green cover of the Botanical Gardens within the city's administrative boundaries.

Methodology

The carbon accumulation and absorption potential of the green cover in Batumi Botanical Garden and the Boulevard was assessed by the IPCC-2003 methodology. For the city landscaping works carried out more recently carbon accumulation potential was evaluated using the CO2FIX model.

IPCC Methodology

Calculations were carried out by the IPCC-methodology within the "living biomass", including underground biomass and its subsequent increase areas using the following equations:

The equation used to determine carbon reserves accumulated in live (underground and above-ground) biomass:

$\Delta C_{F_{LB}} = [V \bullet D \bullet BEF_2] \bullet (1+R) \bullet CF$

where:

V_Wood volume, m3/ha;

D_Volume weight of the absolutely dry wood, tons of dry mass/m3;

BEF_2-Coefficient calculating determination of the total stock of the above-ground woody plants of the commodity wood stock, for producing the aboveground live biomass.

R_Ratio of root mass to above ground tree;

CF_ Carbon ration in dry substance, ton C/ton dry mass.

1.The equation for calculating annual increases in carbon resources in the biomass:

$\Delta C_{F_G} = (A \cdot G_{TOTAL}) \cdot CF$

where

ΔC_{F_G} is the annual increase in carbon stocks due to biomass growth, ton C/year;

A_An area covered by trees - plants;

G_{TOTAL}The average annual increase rates in the total biomass, tons dry weight/ha/year;

$G_{TOTAL} = G_W \cdot (1+R)$,

Where R is the ratio of root mass to the tree .

G_W - Increase in above-ground biomass. Tons/dry mass;

When G_W data is available, it is calculated with the following equation:

$G_W = I_V \cdot D \cdot BEF_1$,

Where:

$I_V$is the average annual biomass increase, m3/ha/year;

D_Absolutely dry wood volume weight, tons of dry mass /m3;

BEF_I-The annual average area increase of wood, the wood biomass to be calculated to the surface ratio.

CO2FIX V 3.1Model

CO2FIX model was elaborated within the CASFOR II project. CASFOR II was funded by the INCO2 Program of the European Union. In addition, the Dutch Ministry of Agriculture, Nature and Food Quality, as well as the Mexican National Council on Science and Technology (CONACYT) supported the project financially.

The CO2FIX V 3.1 model determines carbon accumulation volumes in nature by using a carbon accounting methodology, namely, a model that calculates changes in the carbon inventory in all carbon "reservoirs" of the forests over a specific period of time. Carbon "reservoirs" are considered the part of nature where carbon is stored, such as in live biomass, ground bulk, organic soils, and also wood resources.

Calculations in six main modules in the CO2FIX V 3.1 model were carried out for a scale of one year and one hectare:

1. Biomass module;

2. Soil module;
3. Production module received from wood resources;
4. Bio energy module;
5. Financial module;
6. Carbon credits counting module (for CDM).

According to the model methodology the carbon accumulation volume (CTt) in each time (t) period, is calculated as follows:

$CT_t = Cb_t + Cs_t + Cp_t$ (Mg C/ha)

Where:

Cb_t- The total amount of carbon in ground and underground biomass of the plant (Mg C/ha);

Cs_t- Carbon stocks in the organic soils (Mg C/ha);

Cp_t - Carbon stocks in the wood products produced from forestry-agricultural activity (Mg C/ha).

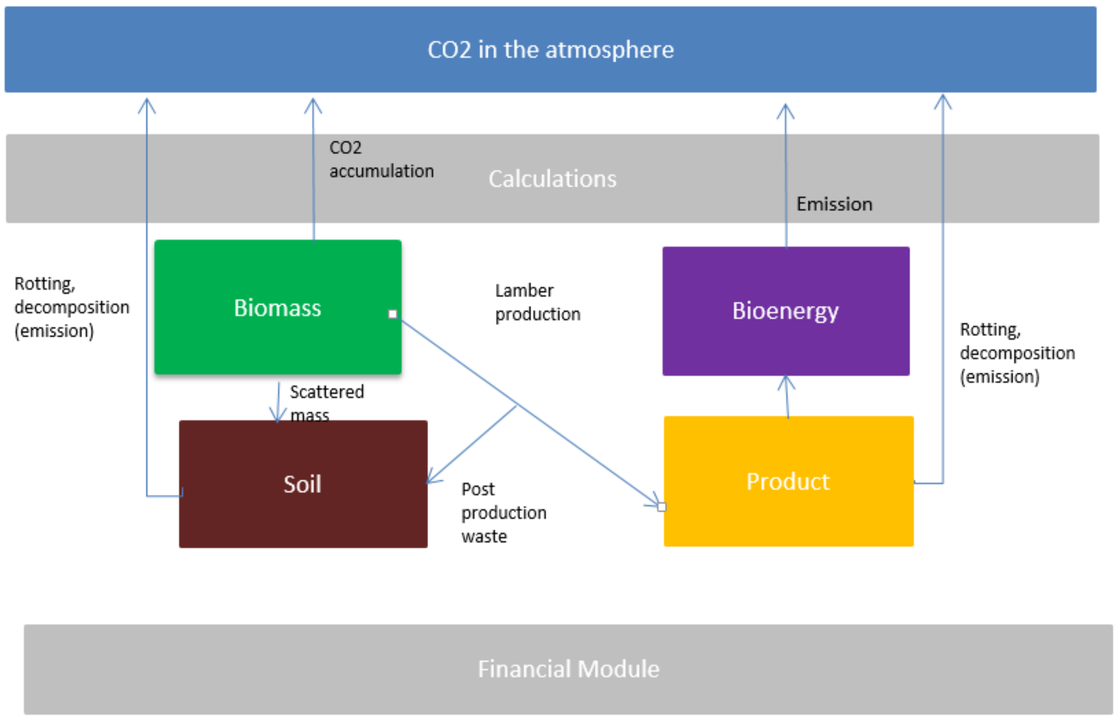


Figure 24. Schematic drawing of the model structure

8.3 Base year inventory

The green wood cover of Batumi is characterized by high diversity mainly determined by the sub-tropical climate. The city includes 601 hectares of greenery, where five parks consist of 215 ha, 40 public squares at 105 ha, and 218 hectares of various fragmented areas . Main species of trees and plants are common in the public areas, with an average age of more than 70 years. A total plant stock of more than 33,000 cubic meters (see Table 56) and a phytomass of vegetation (including underground phyto mass) makes up more than 45 thousand tons with an annual increase of 2 m3/ha.

Batumi's greenery service does not manage or include the Seaside Park and Boulevard with a total area of 103.1 ha, where green lawns occupy 34.8 hectares and the gardens make up 27 ha. Beaches make up 37.5 ha and the Ardavani Lake area has 3.8 ha. Currently, the green surface data of the Boulevard is limited to the species growing on the area and the indicators for their retail cost. There are 33,010 plants along the Boulevard of which 6495 are trees, 16,282 are bushes, 2554 are bamboos, 3125 are palms and the remaining 3125 are flowers. The dominant trees along the boulevard are: coastal pine, cypress, cedar, horse chestnut, Japanese cedar, lime (linden), maple, eucalyptus and three species of palm (date, coconut and rotational).

Pic. 20. *Batumi Boulevard*

The Botanical Garden covers 108 ha, of which 23 ha are planned parks (lower, upper and coastal parks), the floristic division occupies 33 ha, the "collections" occupy 10 ha, the nursery garden is on 6 ha, citrus plantations on 6.5 ha, and the remaining 29.5 ha are recreational zones. About 70 thousand trees and plants are found in the Botanical Garden. The ortho-photo on *Figure 26* shows the total area of the Botanical Garden, with approximately 85% covered by the forests (92 ha). In addition, the orthophoto clearly shows that the forest cover is characterized by a high frequency. This is confirmed by the fact that about 70000 trees-plants are concentrated on 92 ha, i.e. about 760 subtropical and tropical high wood plants are cultivated on 1 ha.

Since no inventory of the plants was performed in the botanical garden and therefore precise data is not available, we will be guided by a variety of sources when calculating the carbon stock in the botanical garden. Namely, by the Ajara forest inventory data for 2004, as well as by the greenhouse gas inventory materials in the forest sector of Ajara from the Third National Notification of 2013. The specific list of used indicators is given in Table 47.

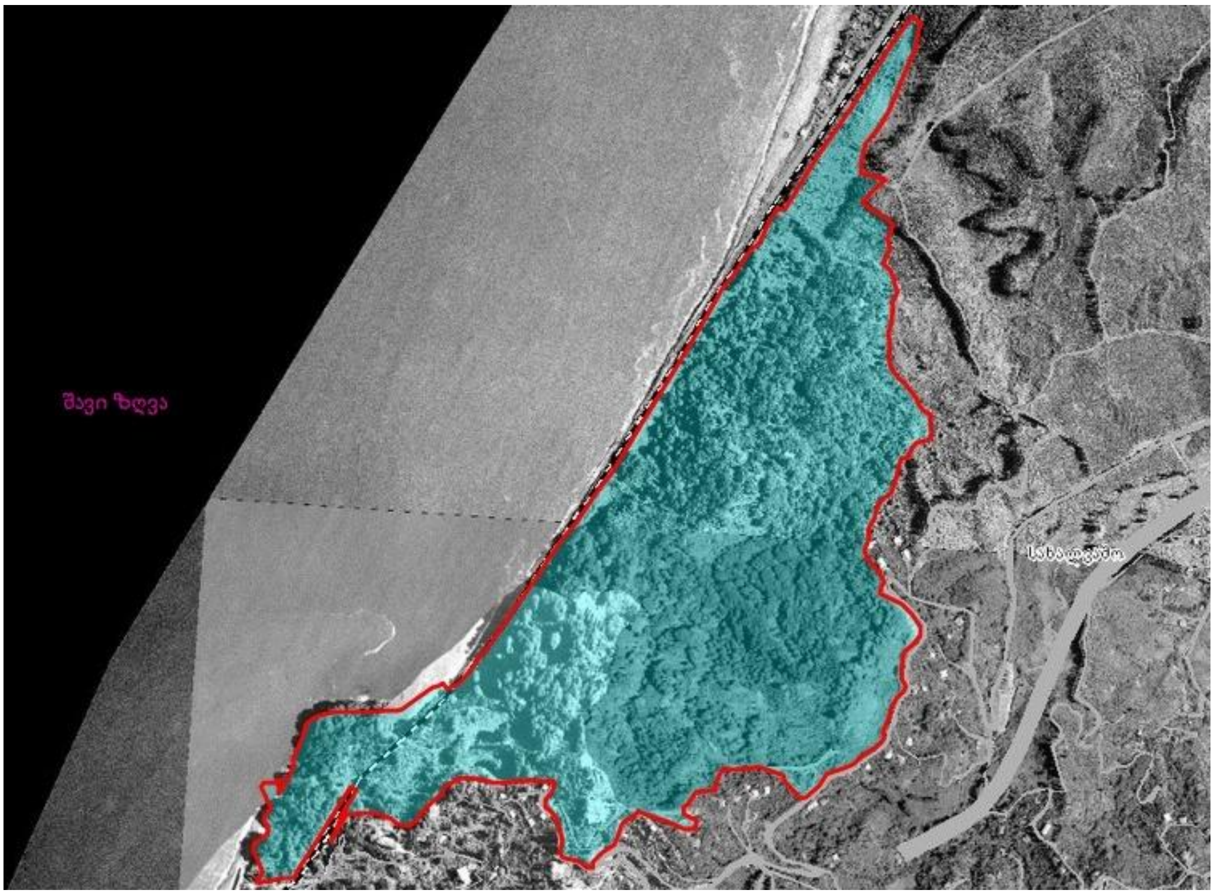


Figure 25. Orthophotograph – Batumi Botanical Garden

Table 56. Average carbon taxation data of the trees/plants for Batumi

Species	Area ha	Average age (years)	Average diameter cm	Average height m	Stock on 1 ha m3	Total stock m3	1 kg ha phyto mass storage X1000		Root	Average increase
							Total	Aboveground		
Trees/Plants										
Magnolia grandiflora	12.00	70-80	64	16	117.00	1 405	1 575.00	1 334.70	320	
Quercusacuta	18.90	60	24	15	21.16	400	448.40	380.00	930	
Eucalyptus viminalis	140.80	80	68	30	151.80	21 377	26 421.90	22 018.30	4 250	
Camellia japonica	132.00	60	16	3	2.66	351	3 917.20	3 264.30	1 300	
Acer japonicum	11.00	40	16	4	25.82	284	316.90	264.20	1 050	
Cedrus deodara	59.40	90	40	18	53.40	3 172	4 535.96	3 489.20	2 250	
Pinus	4.20	35	20	5	7.14	30	331.50	255.00	120	
Laurocer asus	1.10	15	16	4	1.09	1	1.78	1.32	50	
Osmanthus fragrans	2.20	90	16	4	0.68	2	1.80	1.39	70	
Lagerstroemia indica	26.40	40	16	3	2.84	75	96.19	71.25	2 300	
Ternstroemia japonica	2.20	50	12	4	0.91	2	1.07	0.91	50	

Cupressus sempervirens f. Pyramidalis	8.80	60	28	25	14.54	128	176.14	140.80	220	
Cupressus sempervirens f. Horizontalis	19.80	60	28	20	14.65	290	376.42	319.00	500	
Juglans regia	33.00	50	32	8	36.82	1 215	1 737.50	1 336.50	1 500	
Olea europaea									10	
Podocarpus									15	
Eriobotrya japonica	4.20	30	16	4	19.05	80	96.72	74.40	300	
Prunus cerasifera	11.00	30	16	4	15.91	175	211.57	162.75	700	
Magnolia soulangeana	4.20	20	12	5	6.70	28	36.00	27.70	100	
Liriodendron tulipifera	1.10	100	44	20	16.40	18	21.80	16.70	10	
Paeonia arborea	4.40	20	4	3	1.10	5	6.00	4.60	300	
Pirakanta									20	
Michelia									25	
Juniperuc Sabina	2.20	New	6	1		-			40	
Cinnamonum camphora	8.90	90	64	15	103.40	920	1 136.20	874.00	200	
Total, trees/plants	508.80					29 957.70	41 446.05	34 037.02	16 560	

Palms										
Washingtonia filifera H. Wendl.	22.00	60	56	25	93.10	2 051	2 481.70	2 256.10	1 000	
Trachycarpus fortunei	13.20	50	24	15	36.10	476	576.00	523.60	500	
Chamaerops humilis L.	2.20	70	24	4	1.40	3	3.60	3.30	30	
Phoenix canariensis	11.00	50	44	10	41.50	456	551.80	501.60	300	
Butia capitata	2.20	50	44	10	1.40	3	3.60	3.30	20	
Thuja	11.00	60	24	12	10.40	114	130.00	108.30	300	
Total palms	61.60					3 103	3 746.70	3 396.20	2 150	
Bushes										
Abelia	4.40	25	6	1.50	6.40	28.00	39.90	26.60	300	
Ilex	2.20	20	3	0.50	0.90	2.00	2.80	1.90	50	
Euonymus	2.20	20	2	0.50	0.90	2.00	2.90	2.00	60	
Chaenomeles japonica	2.60	30	8	2.00	1.20	3.00	4.30	2.90	50	
Photinia	2.20	20	2	0.50	0.90	2.00	2.80	1.90	50	

Spiraea, *kalistemoni*, Leptospermum, Gardenia,Forsythia Hibiscus, Mutabilis, Nandinadomestica, Rhododendron catibiense.	17.00	0-20	4	1.00	3.20	55.00	78.40	52.20	1 100	
Total bushes	30.60					92.00	131.10	87.50	1 610	
Total plants/trees Batumi	601.00					33 152.70	45 323.85	37 520.72	20 320	2

By using the equations from the methodology, carbon stocks and increases were calculated for green zones within the area of Batumi City Hall, *LLP Batumi Boulevard* and the Botanical Garden separately.

Table 57. Coefficients used in the calculations and their source

Main indicators used in calculations	Green Cover of Batumi City	Batumi Boulevard	Batumi Botanical Garden
A-Area of Green Cover, ha[15]	601.00	27.00	92.00
V- Tree - plant supplies, m 3 / ha[16]	55.00	55.00	266.00
D-Volume weight of the very dry wood, tons of dry mass/m3[17]	0.41	0.41	0.55
I_V- Average annual biomass increase, m3/ha/year[18]	2.00	2.00	4.00
BEF_1- annual average wood area increase, the wood biomass to be calculated to the surface ratio[19]	1.15	1.15	1.05
BEF_2- Coefficient calculating determination of the total stock of the above-ground wooden plants of the commodity wood stock, for producing the aboveground live biomass.[20]	1.30	1.30	1.30
R - Ratio of root mass to the tree[21]	0.24	0.24	0.24
CF- Ratio of root mass to the tree [22]	0.50	0.50	0.50

Some of the coefficients required for the calculations were taken from Table 47. In particular, the green cover area per hectare, and the average annual increase and trees-plants numbers. To determine the weighted index for the wood volume weight (D), the prevailing existing wood plants was used. The parameters for the remaining coefficients (BEF1, BEF2, R, CF) were taken from the IPCC methodology, in particular, from the list of the standard indicators acceptable for Ajara's climate.

As the Batumi Seaside Park (Boulevard) unlike Batumi city, is characterized by a lack of vegetation data --and in order to increase the accuracy of the data for the Boulevard-- the relevant data for the city were used, especially when taking into account that the composition of the city and the boulevard green cover is not very different from each other.

There is also a scarcity of accurate data for the Botanical Garden. Since the landscape of the Batumi Botanical Garden is significantly different from flat park landscapes located in Batumi, and more like a typical subtropical forest landscape characterizing the Ajara coastline with many species of tropical and subtropical vegetation, calculations are taken from a 2004 forest management plan—and particularly the characteristics for the forest stand covered with subtropical plants. The greenhouse gas inventory materials of the forest sector in with the Third National Notification (2004) were also used. By considering the dissemination of various plants in the botanical garden, the absolutely dry wood volume weight (weighted) index for the plants of the Botanical Garden was determined.

The indicators derived from calculations in the project recreational zone facilities are given in the following table:

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[15] The greening service of Batumi, Administration of "Bulvari" .

[16] Administration of the city of Batumi, Inventory of Ajara forests 2004.

[17] "Global Wood Database" http://datadryad.org; Makhviladze S.E. "Merkanmtsodneoba" Tbilisi 1962; Боровиков А.М., Уголев Б.Н..Справочникподревесине. "ЛеснаяПромышленность", Москва, 1989;

[18] The characteristics of Batumi trees and plants, Inventory of Ajara forests 2004

[19] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.10;

[20] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.10;

[21] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.8;

[22] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003).

Table 58. Carbon dioxide accumulation and expenditure figures on project facilities

Project facilities	Total accumulation of carbon stocks, TC	Accumulation of carbon on 1 ha TC	Carbon/carbon dioxide annual deposition			
			Annual increase in carbon storage TC	Annual absorption of carbon dioxide, CO2GG	Increase in carbon storage on 1 ha, TC	Annual absorption of carbon, CO2GG
Batumi City Recreation Area	10 938.00	18.20	361.00	1 324.00	0.60	2.20
Green cover of the Boulevard	491.00	18.20	16.00	59.00	0.60	2.20
Batumi Botanical Garden green cover	10 856.00	118.00	129.00	473.00	0.70	2.60

Below is shown the calculation course for each project facility according to the results:
Carbon reserves accumulated in the recreation zones of Batumi

$$\Delta C_{F_{LB}} = [V \bullet D \bullet BEF_2] \bullet (1+R) \bullet CF = [55 \bullet 0.41 \bullet 1.3] \bullet (1+0.24) \bullet 0.5 = 29.3 \bullet 1.24 \bullet 0.5 = \mathbf{18.2tC/HA,}$$

Respectively, 10938 tons of carbon are accumulated in the vegetation of Batumi. Storage collected annually in recreational areas:

$$\Delta C_{F_G} = (A \cdot G_{TOTAL}) \cdot CF = 601 \cdot 1.2 \cdot 0.5 = \mathbf{361tC}$$

$$G_{TOTAL} = G_W \cdot (1+R) = 0.94 \cdot 1.24 = 1.2$$

$$G_W = I_v \cdot D \cdot BEF_1 = 2 \cdot 0.41 \cdot 1.15 = 0{,}94$$

1 hectare of Batumi recreation area annually collects 0.6 TC/ha

The accumulated carbon storage in vegetation of the Boulevard and the annual increase rate are identical to the relevant indicator for Batumi; the only difference is in the annual rate of carbon resources:

$$\Delta C_{F_G} = (A \cdot G_{TOTAL}) \cdot CF = 27 \cdot 1.2 \cdot 0.5 = \mathbf{16.2tC.}$$

The accumulated carbon storage in the Botanical Garden:

$$\Delta C_{F_{LB}} = [V \bullet D \bullet BEF_2] \bullet (1+R) \bullet CF = [266 \bullet 0.55 \bullet 1.3] \bullet (1+0.24) \bullet 0.5 = 190 \bullet 1.24 \bullet 0.5 = \mathbf{118tC/HA,}$$

Consequently, 10,856 tons of carbon is accumulated in the green cover of the Botanical Garden.
The annual accumulation of carbon in the vegetation resources of the Botanical Garden:

$$\Delta C_{F_G} = (A \cdot G_{TOTAL}) \cdot CF = 92 \cdot 2.8 \cdot 0.5 = \mathbf{129tC}$$

$$G_{TOTAL} = G_W \cdot (1+R) = 2.3 \cdot 1.24 = 2.8$$

$$G_W = I_v \cdot D \cdot BEF_1 = 4 \cdot 0.55 \cdot 1.05 = 2.3$$

Consequently, 1 hectare area of the Botanical Garden annually collects 0.7 TC/ha.

In 2014, 22 plant species will be added to Batumi's parks and gardens, 4 of which are trees (cedar, cypress, pine, maple) and 3 are palms, while the others are bushes and flowers. A total of planting of 3380 saplings and seedlings are planned for a total of one ha of land.

CO2 absorption and carbon accumulation capacities after 70 years of planting have been calculated according to co2fix model. According to the scenario envisaged by the project (recovery-cultivation of plants), calculations were used for selecting the model of two modules, namely: biomass and soil modules.

1. Biomass module

For biomass module calculations the "cohort" system is used. The cohorts include one or various groups of wood plant species. The species unified in each cohort are characterized separately in the module by growth, dessication and other features.

Table 59. Required and used characteristics in the biomass module according to the project scenario

Characteristics listed in the biomass module	Indicators of the characteristics
Carbon content in biomass	0.5 tons. C/T. Dry mass
Wood density/T. Dry mass	
Cedrus	0.58
Cypress	0.54
Pinus contorta	0.48
Maple	0.48
Catalpa	0.75
Initial carbon storage	0tC/ha
Growth correction factor	1.00
Phytomass turnover rate (Branches, roots) the annual rate of natural death	
Coniferous:	
Needles	0.30
Branch	0.04
Root	0.03
Leafy:	
Leaf	1.00
Branch	0.05
Root	0.08

Soil Module

The Yasso-model was used to determine soil carbon dynamics (http://www.efi.fi/projects/yasso/). This model (model is included in the CO2fix system) describe dry soil carbon dissolution and its dynamics. This model is calibrated to describe the total carbon stocks in soils, regardless of soil layers. The model can be used for coniferous and deciduous forests and has been tested in countries with various climatic zones to describe the effect of different climatic conditions on the decay of fill.

Table 60. Characteristics used in the soil module

Characteristics used in the soil module	**Indicators of the characteristics**
Resultant subtotal of the temperature during the year (zero above T)(Cºd)	5,310.50
Evapotranspiration (PET,mm)	628.60
Sediment volume during the vegetation period (mm);	1 654.00
Average monthly temperature indicators during the vegetation period	
March	8.80
April	12.20
May	12.20
June	20.20
July	22.50
August	22.80
September	20.00
October	16.20

Based on characteristics the model calculations include: the magnitudes of annual accumulation after planning of greenery planting in 2014 as shown in picture 27, and the accumulation dynamics for the next 70 years shown in the table created from the model (see figure 28). From the summarizing table of the model we see that, for example, within 10 years from planting 1 ha of plantation 80.8 t C is accumulated and consequently 296.5 GG CO_2 will be deposited.

Figure 26. The carbon accumulation and carbon dioxide absorption rates after the planned landscaping.

	Sequestered Carbon urban refor...	Sequestered Carbon urban refor...		Sequestered Carbon urban refor...	Sequestered Carbon urban refor...		Sequestered Carbon urban refor...	Sequestered Carbon urban refor...		Sequestered Carbon urban refor...	Sequestered Carbon urban refor...
year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...	year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...	year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...	year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...
0	0.00	0.00	21	158.70	581.91	41	250.16	917.24	61	310.96	1140.17
1	4.47	16.40	22	164.24	602.20	42	253.99	931.28	62	313.18	1148.34
2	10.10	37.04	23	169.57	621.76	43	257.74	945.05	63	315.35	1156.27
3	16.96	62.18	24	174.71	640.61	44	261.43	958.56	64	317.45	1163.99
4	24.74	90.71	25	179.66	658.77	45	265.04	971.81	65	319.50	1171.50
5	33.43	122.56	26	184.44	676.27	46	268.58	984.81	66	321.49	1178.81
6	43.01	157.72	27	189.17	693.63	47	272.03	997.44	67	323.43	1185.91
7	52.93	194.06	28	193.87	710.85	48	275.35	1009.63	68	325.31	1192.81
8	62.56	229.40	29	198.53	727.95	49	278.56	1021.40	69	327.14	1199.51
9	71.88	263.57	30	203.17	744.96	50	281.67	1032.80	70	328.92	1206.03
10	80.87	296.52	31	207.77	761.83	51	284.69	1043.88			
11	89.58	328.45	32	212.32	778.49	52	287.64	1054.67			
12	97.88	358.88	33	216.80	794.93	53	290.51	1065.20			
13	105.81	387.96	34	221.22	811.14	54	293.31	1075.49			
14	113.40	415.80	35	225.57	827.11	55	296.06	1085.55			
15	120.70	442.56	36	229.86	842.83	56	298.75	1095.41			
16	127.72	468.32	37	234.08	858.29	57	301.35	1104.95			
17	134.40	492.81	38	238.21	873.44	58	303.87	1114.18			
18	140.82	516.35	39	242.27	888.32	59	306.30	1123.11			
19	147.00	539.01	40	246.25	902.92	60	308.67	1131.77			
20	152.96	560.85									

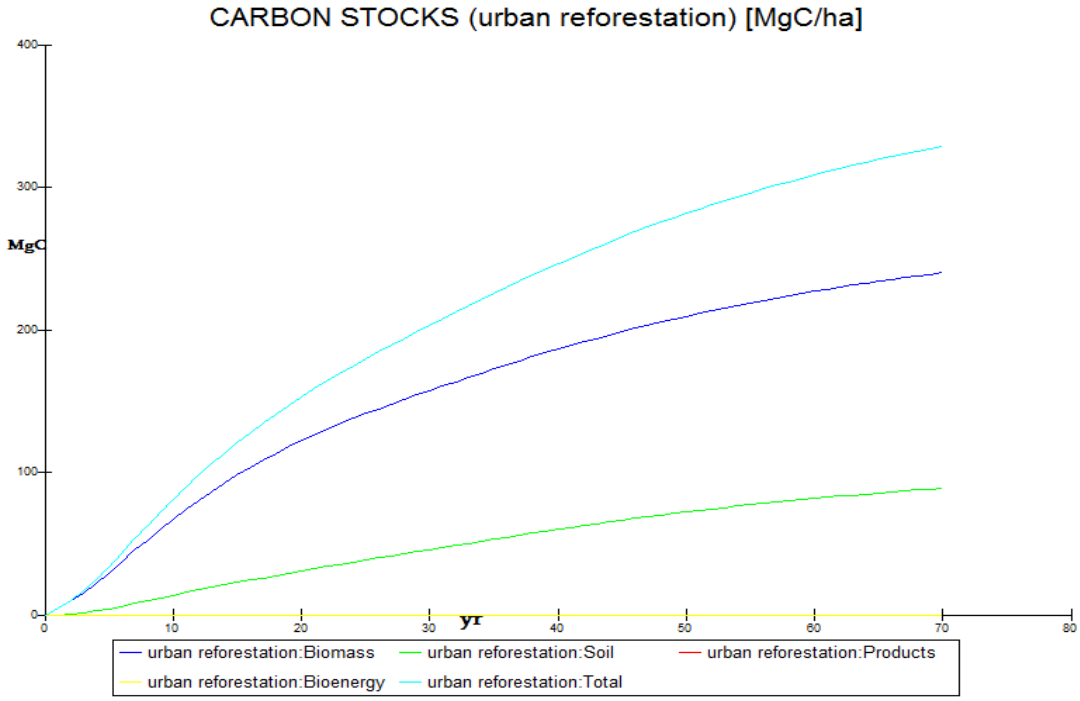

Figure 27. Accumulated carbon dynamics after cultivation.

To demonstrate carbon accumulation in the biomass as a result of urban development in Batumi in the coming years, we assumed that one hectare of greenery will be added each year. The carbon accumulation annual volume from 2014 through 2019 is shown in the table 51.

Table 61. Annual carbon accumulation as a result of the greenery planting on 1 ha in 2014-2019, TC

Cultivation year and annual increase	2014	2015	2016	2017	2018	2019	2020
2014	4.50	10	17	25	33	43	53
2015		4.50	10	17	25	33	43
2016			4.50	10	17	25	33
2017				4.50	10	17	25
2018					4.50	10	17
2019						4.50	10
2020							4.50
Total	**4.50**	**14.50**	**31.50**	**56.50**	**89.50**	**132.50**	**185.50**

This planting will result in a total of 185.5 TC accumulated; consequently the absorption of CO2 is 680 GG.

THE IMPACT OF TRAINING AND AWARENESS RAISING OF BATUMI SOCIETY AND TARGET GROUPS ON THE PERSPECTIVES OF SUSTAINABLE ENERGY DEVELOPMENT AND ITS ECONOMIC AND SOCIAL RESULTS

Developing sustainable energy implies the inclusion of both state and public structures and both sides should be interested in achieving results. Raising public awareness on renewable energy, energy efficiency and energy savings requires a complex and multilateral approach. A relevant communication strategy is one of the most important components of the Sustainable Energy Action Plan (SEAP).

The SEAP preparation process within the framework of the Covenant of Mayors (CoM) revealed constraints that could create significant threats to implementing the strategy. It is important to evaluate all the identified barriers and develop ways to overcome them. The evaluation revealed three main barriers that exist generally in the whole country, which have been triggered by past practices, especially where public awareness is concerned. Socio-economic problems and a lack of technological knowhow are additional drawbacks and there are barriers unique to the region of the Autonomous Republic of Ajara and the City of Batumi.

Existing barriers to the process of sustainable energy development in Georgia

1. **Wasteful approach to the energy sector**, inherited from the Soviet period by the general public, as energy was almost free and unlimited at that time.
2. **Lack of general awareness of sustainable development processes.** Only some of society, or those directly connected to and interested in the issues are aware of the concept.
3. **Lack of a unified vision of long-term development perspectives in the sustainable development of the energy sector** (various interest groups have divergent positions, which are not often based on real estimations).
4. **There is no single, well thought out or formulated vision on the role of the energy efficiency and renewable energy resources** or short- and long-term development perspectives of Georgian energy sector. As there is an annual 10% growth in demand, energy potential (except hydro) and its use are not defined. For instance, there is no appropriate legislative framework or goals set for gasification or hydro-energy areas.
5. **Technology is underdeveloped.** The failure of every new technology and pilot project seriously impacts perspectives of further developments in this area. Long-term planning in the energy sector does not take into consideration accessibility to new technologies.
6. **Work undertaken by specific non-governmental organizations on energy efficiency and renewable energy (except hydro) are mainly un-coordinated and ineffective.** The overall process of increasing energy efficiency in Georgia is chaotic, partly due to modernization of households and the introduction of international energy standards for Georgia.

While identifying barriers it should be considered that the Batumi City Municipality is very progressive and understands the future perspectives of sustainable energy development. They express a strong interest in introducing clean, energy efficiency and renewable technologies.

Barriers to the sustainable energy development in Ajara and Batumi

1. Ajara and Batumi municipality in particular, face all the barriers common to Georgia, especially those of local towns similar to Batumi. One is their **full dependence on a centralized energy supply in the electricity sector**. This dependence is particularly true in the case of the gas supply sector. Here,municipalities mainly depend on planning by the central government. Petrol, diesel and other fuels are the prerogative of private importers.
2. Batumi municipality does not collect energy consumption statistics on which to base planning for the energy demands. There is no vision or alternative strategy to supply energy if one sector is down. There is no plan for future potential energy deficit problems posed by expanding tourism.
3. The municipality has no sufficient experience, knowledge or trained personnel to plan or carry out a sustainable energy strategy for Batumi.
4. There are no available financial resources for energy development policies in Batumi as they are concentrated on infrastructure development and on social projects without a vision of sustainability.
5. The sector of energy consumption is uncontrolled and chaotic at the municipality level, as well as nation-wide.

In addition to these barriers, and those of technological development, specific barriers for private technologies should be taken into account when selecting technologies to implement SEAP.

Barriers connected to technologies:

1. **A lack of knowledge of modern and affordable energy efficient and renewable technologies existing on the international market.** New technology is not being developed in Georgia except for a few cases. This significantly increases the risks of not obtaining necessary technology for the program as private banks and the private sector do not want to take investment risks, so any new technologies are exclusively in the hands of the non-governmental sector or large investors interested in creating a market for their own prodcts. This is why high quality products are introduced in Georgia in small quantities then are followed by a flood of poor-quality technologies. This is made worse by the fact that costs usually guide the process , which is a short-sighted perspective.

2. **A lack of the knowledge of the local environment where technologies will be used** (for example, energy- efficient bulbs are absolutely ineffective and economically unprofitable in the places where the electricity network is old and inefficient). Such studies become an extra cost for the technologies.

3. **A lack of knowledge about environmental and social conterindications.** Studying technological risks requires a good knowledge of the technology from the receiver's side in order to assess and minimize the risks of adapting the technology to the context.

4. **A lack of experienced local staff** able to correctly select the technologies for the local conditions and use them appropriately. This problem is especially true for smaller municipalities and towns.

5. **Renewable technologies are often not sufficiently flexible and easily adaptable to different environments.** Most are not marketed to be adapted to local conditions without money and knowledge.

An analysis of those interested in the framework of the SEAP revealed that the target groups for training and awareness raising need the active work of experts to overcome the identified barriers. Barriers exist at the national level and must involve the central government.

The present strategy reviews the following target groups: Personnel of the Batumi City Municipality, members of the Municipal Council (Sakrebulo), the general population of Batumi and the private sector and in particular the tourism service facilities and industrial sectors.

To implement the SEAP an accent must be made on activities requiring a change in habits and behaviours of the population. Such changes may initially cause discomfort and protest, so to avoid negative public opinion and strengthen positive opinion, the reasons for designing SEAP and the goals of planned activities must be clear to all. The population should be involved at a maximum level in the early stages, which will make it easier to carry out subsequent stages and to have public support.

When SEAP is initiated frequent meetings should be organized and consultations carried out with the population and different sectors where the most changes are planned. These discussions must include the necessity for implementing the project and the benefits to the city and its population. This consultation process may identify ideas for new projects or adjustments for planned projects.

As SEAP was designed for Batumi, meetings were conducted with representatives of the appropriate departments at the Batumi Mayor's office and the municipal organizations in transportation, energy, tourism, urban development, greenery and cleaning sectors. Additionally interested groups included energy supplier companies, potential investors for pilot projects and financial partners (banks, financial organizations), associations of businessmen, architects and other professional associations, private construction and transportation companies, non-governmental organizations, experts in these sectors and other interested citizens. It is important to note that those most interested are persons with the knowledge necessary to designing the plan and creating the basis for success.

The strategy to raise awareness on the Batumi SEAP and personnel training consists of the following steps:

Short-term strategy (2014-2016):

1. Informing local authorities about advantages and perspectives of ensuring city's sustainable energy consumption and socio-economic profitability of the initiative.
2. Training municipality workers and outside human resources to ensure successful implementation and monitoring of the SEAP.
3. Ensuring the maximum inclusion of the city's population in the design and implementation of pilot project proposals (e.g. related to residential buildings), while demonstrating the advantages of energy efficiency measures and technologies.

Medium-term strategy (2017-2019)

1. Activities targeting the lifestyle changes by the population, by increasingly acquainting them with new technologies (energy efficiency of the buildings, private cars, waste generation etc.) and strengthening awareness-raising. Prepare information materials on the reasons for behaviour changes and on recommended technologies for the green development of the city and a healthy environment that will attract more tourists.
2. Increase the inclusion of the private sector by providing information on energy saving and economically beneficial technologies by offering both the public and private sectors special cooperation programs.

Long-term strategy (2020 and after)

1. Multiply consultations with interested parties such as the city's population, private sector, non-governmental sector on regulations and standards that must be implemented by the municipality in sectors like construction, transportation and waste management.
2. Identify possible barriers against introducing regulations and create various standards with the interested parties.
3. Design and implement awareness raising and promotional programs for specific target groups, e.g. for ensuring the unimpeded introduction of energy efficiency.

For the successful implementation of the Batumi SEAP in the area of personnel training and awareness raising

Main strategic goals	Main target groups	Implemented activities	Potential leading organization (s)	Result	Potential donors
<u>Short-term plans (2014-2016)</u>	Batumi City Municipality and Council (Sakrebulo) The city population of Batumi	Include the city population in the process at the maximum level and assist them in selecting and training relevant staff to ensure implementation and monitoring of the Action Plan.	Batumi Mayor's office Coordinator of the Covenant of Mayors in Georgia (Ministry of Energy and Ministry for Environment Protection and Natural Resources). Various local and international programs implemented within the framework of the initiative of designing the strategy for the Covenant of Mayors and mitigation of emissions.	SEAP for Batumi is successfully implemented. Batumi Mayor's Office continues the same activities after 2020. The Batumi population has implemented a range of energy efficiency measures. The Batumi population understands and approves the initiatives of the city government related to this process.	Batumi Mayor's office Coordinator of the Covenant of Mayors in Georgia (Ministry of Energy and Ministry for Environment Protection and Natural Resources). Local and international programs implemented within the framework of the initiative of designing the strategy for the Covenant of Mayors and mitigation of emissions. International donors working on mitigation of climate change and renewable energy, also on promoting processes related to energy efficiency and sustainable energy development.
Staff training					
Train technical staff to undertake qualified work and provide recommendations for successful implementation of the technical processes within the CoM.	Technical group of Batumi Mayor's Office Special Unit established under the Mayor's Office (this could be the Energy Efficiency Center, which will serve the Mayor's office, as well as the population and the private sector).	• Establish a technical group/unit at the Mayor's office or outside its competence, to provide service to the Mayor's Office, the city population and private sector from the beginning of SEAP implementation, and which will propose introduction of new technologies. • Elaborate a program for training the technical group that includes energy efficiency, mitigation of climate change measures, EU directives, demands of the CoM and analyses of modern technologies to identify barriers. • Prepare training manuals for the technical group. • Include the technical groups in exchange programs and international information networks. • The Technical group should be included from the beginning of SEAP.	Batumi Mayor's office Ministry of Energy and Ministry for Environment Protection and Natural Resources CoM representative in Georgia (at this stage, the Energy Efficiency Center).	A Training program and manual for the technical group and personnel of the Mayor's office is prepared. Personnel is trained and selected as a result of the competition and their rights and responsibilities and working program are clearly designed. The program envisages cooperation with the Mayor's office, as well as with the private sector. The Technical group is actively involved in exchange programs and international networks. The Technical group is ready to train personnel in the private sector.	Batumi Mayor's office EC-LEDS Project USAID GIZ EU

Raising Public- awareness with full public inclusion and provision of information					
Provide information and include the public in the process from the beginning helps avoid misunderstandings between them and city authorities. Society should receive the socio-economic benefits achieved by the sustainable energy development process. At first the main direction in Batumi will be to consult the population about energy efficiency measures in the buildings, informing them about technologies existing on the market and on best international practices.	Home-owners associations (apartment buildings) Non-governmental sector and other public unions	Create information materials for the city population on measures and technologies that can improve the residential environment and help them save costs on energy consumption. Regular meetings with the public should be held, as well as training demonstrations in the apartment buildings. The public will be included in the design and implementation of pilot projects.	Batumi Mayor's office Non-governmental sector	TV advertisement and information booklets about technologies available on the market and advantages of their use prepared for the Batumi population. A pilot project is being implemented in several years (2 years) for ensuring inclusion of the population at the maximum level	Batumi Mayor's office USAID GIZ EU
Informing the representatives of Batumi City Municipality and Council (Sakrebulo)					
Informe local authorities about advantages and perspectives of city's energy efficiency and socio-economic profitability of this initiative.	Batumi Mayor's office Batumi Council (Sakrebulo)	Organize discussions for the Batumi Mayor's office and Council (Sakrebulo) on advantages and perspectives of energy efficiency. Facilitate staff participation at the Mayor's office and Council (Sakrebulo) in national and international events within the CoM. Include the media in important meetings within CoM to help them inform the public. Ensure the process of making decisions in the framework of CoM through the consultations with the interested parties.	Batumi Mayor's office Batumi Council (Sakrebulo) Regional Energy Efficiency Center	Illustrative materials for organizing information meetings prepared Minimum 2 meetings per year conducted. Experts on modern technologies and approaches from the EU and other donor countries invited for organizing seminars. Dissemination by media of decisions, projects and measures The representatives of the Mayor's office and Council (Sakrebulo) fully involved in the processes at national and international levels. Information on the projects and processes updated on the web-site of the Mayor's office.	EC-LEDS USAID EU-COM GIZ Partnership for mitigation Projects on emissions of GHG The Third National Notification of Georgia on Climate Change
Medium-term goals (2017-2019)	Residents of Batumi; Private sector in Batumi (with a focus on tourism development and service industry).	Activities to change life style behavior. Increased inclusion of residents in the use of new technologies (energy efficiency of homes, private cars, waste generation etc.) Prepare materials on good practices and technologies for green development and on the healthy environment to attract more tourists. Increase private sector in SEAP implementation by providing information about energy saving and economically beneficial technologies, offering the public and private sector cooperation programs.	Batumi Mayor's office Batumi Council (Sakrebulo) Regional Energy Efficiency Center		Government of Georgia Batumi City authorities Projects on climate change USAID EU-COM GIZ UNDP

Activities targeting behavioural changes of the Batumi population					
Increase public participation in new technologies (energy efficiency of the buildings, private cars, waste generation etc.) by strengthening awareness raising process. Prepare informative and illustrative materials oriented on the successful practice of behavioural change. Prepare materials on recommended technologies for the green development of the city and on the healthy environment that would attract more tourists.	Home-owners associations (apartment buildings) Owners of the private cars Tourists Tourist service sector Various energy consumers and their associations Non-governmental sector	Identify target groups (kindergartens, private car owners, representatives of tourism industry, municipal facilities, population etc.) according to the priority areas and directions of the SEAP. Include invited experts and specialists. Design promotion mechanisms for target groups (for example rewarding apartment buildings that save the most energy).	Batumi municipality Mass media Non-governmental sector	Interest groups are identified Information and illustrative materials about best practices are prepared. Ads prepared about the barriers and mechanisms Promotional mechanisms prepared to promote behavioural change in favour of energy saving Clean technologies for target groups prepared	EU-COM and its various programs Batumi Mayor's office EC-LEDS process Green Economy programs
Including the private sector in achieving SEAP goals					
Strengthen involvement of the private sector in the SEAP by informing them about energy saving and economically beneficial technologies, and offer public-private sector cooperation programs	Private sector Initiative groups from the private sector	Create an annual exhibition/festival of innovation and technologies in Batumi. One of the goals of the event should be informing the private sector about the opportunities on the modern technological market. Attract the private sector by promotional mechanisms in using innovative technologies (e.g. tax benefits fo companies that implement energy saving and innovative technologies). Create a stimulus for research for the educational organizations and private sector. Develop a Consultation service for the private sector to reduce risks. Establish funds to promote implementation of new technologies and decrease risks of adaptation. Promote a private sector initiative group to support inclusion of this sector in CoM processes.	Batumi Mayor's office Energy Efficiency Center Private sector initiative group	Support an annual exhibition/festival of innovation and technologies in Batumi. Promotional mechanisms for using innovative technologies and attracting the private sector designed. A Center for Energy Efficiency and Technologies is established, to consult with the private sector on new technologies. Funds to promote new technologies and increase probabilities of success. Private sector representatives included in international lmeetings and professional networks.	Ajara government Batumi Mayor's office Private Sector EU COM GEF UNFCCC programs
Long-term strategic goals (2020 and after)	Batumi Mayor's office Batumi Council (Sakrebulo) Residents of Batumi Representatives of private sector (with a focus on tourism and service industry) NGO sector	Intensify consultations with all parties (public, private sector, non-governmental sector) about regulations and standards to be implemented by the municipality in various sectors (construction, transportation, waste generation). Identify possible barriers to the introduction of regulations and standards. Designing and implementing different awareness raising and promotional programs for various target groups (for example, for ensuring the unimpeded introduction of energy efficiency).	Ajara government Batumi Mayor's office CoMprograms	• The authorities in Batumi is ready for the introducing new standards in the process of the approximation with EU directives and supporting CM initiatives • The population and the private sector understand the necessity of implementing these measures.	

Consultations with the interested parties on introducing regulations and standards					
Intensification of consultations with the interested parties (city's population, private sector, non-governmental sector) about regulations and standards that should be implemented by the municipality in various sectors (construction, transportation, waste generation).	Batumi Mayor's office Batumi Council (Sakrebulo) Residents of Batumi Representatives of private sector (with a focus on tourism and service industry) NGO sector	Inform city's population, private sector, non-governmental sector and other target groups about regulations and standards that should be implemented by the municipality. Create videos and programs to demonstrate the socio-economic benefits of these measures, for example, develop tourism etc. Train/prepare people who will directly and regularly work with the target groups.	Batumi Mayor's office Regional Center of Energy Efficiency and Innovative Technologies NGO sector	Personnel prepared to work with target groups. Systematic Clarifications and consultations on SEAP measures and standards to improve socio-economic conditions in Batumi and attract more tourists. Non-governmental sector is actively working with the public and target groups. Mass-media is actively included in the activities and the socio-economic benefits are clarified (videos, talks etc.)	Ajara government Batumi Mayor's office Batumi Sakrebulo
Identify barriers together with the interested parties					
With the interested parties, Identify possible barriers accompanying the process of introducing regulations and standards.	Batumi Mayor's office Batumi Council (Sakrebulo) Residents of Batumi Representatives of private sector (with a focus on tourism and service industry) NGO sector Hotels in the city	With the interested parties, identify possible barriers accompanying the process of introducing regulations and standards. Design measures for overcoming these barriers in consultation with various target groups (for example, prohibition of transportation on a street should not happen suddenly, but implemented gradually through prohibitions on certain days, etc. some regulations should come into effect immediately, e.g., technical examination for cars etc.	Batumi Mayor's office Batumi Council (Sakrebulo)	Groups are prepared (private sector initiative group, non-governmental sector, mass media) for conducting consultations. Barriers are identified for each sector in the SEAP. Activities for overcoming the barriers are planned with the target groups	Batumi Mayor's office
Raising awareness of decision-makers, as well as private and public sector representatives on the role of regulations and standards to ensure sustainable energy					
Design and implement awareness raising and promotional programs for various target groups (for example, for ensure unimpeded introduction of energy efficiency). To ensure smooth implementation, this part will target awareness of the decision-makers and the private and public sector representatives and their preparedness of the processes	Batumi Mayor's office Batumi Council (Sakrebulo) Residents of Batumi Representatives of private sector (with a focus on tourism and service industry) NGO sector	Inform decision makers and implementators about best international practices. Including decision makers and implementators in wider processes related to CoM and low emission development. Raise awareness on the role of regulations and standards in ensuring sustainable energy efficiency, an attention should be paid to the necessity of energy efficiency consumption for Georgia to achieve energy independence. When discussing the regulations and standards in the media, attention should be paid to social and environmental issues, and tourism. When informing private sector on regulations and standards, attention should be paid to social and environmental issues, promotion of tourism.	Ajara government Batumi Mayor's office CoM programs and projects	Decision makers and implementators are informed about international norms and Georgia's obligations on energy change and energy efficiency. Information packages are prepared, and the CoM is analysed thoroughly in the context of implementing EU directives. Manuals on best practices are designed. Inclusion of foreign experts in the process is necessary.	Georgian government Ajara government EC-LEDS EU-CoM GIZ Clima East Other projects offered in the future

Implementation structure

- This strategy is approved and monitored by the Batumi City Council (Sakrebulo) as part of the Action Plan.
- Batumi City Mayor's Office is responsible for its implementation.
- The Regional Center of Energy Efficiency and Innovative Technologies is responsible for the implementation and monitoring of the trainings of the local personnel. For this purpose, international and local programs within the CoM framework are used.
- The awareness raising and information materials should be mainly designed with the outside resources (non-governmental sector).
- Organization of international conferences and technologies.

MONITORING, VERIFICATION AND REPORTING IMPLEMENTATION OF THE SUSTAINABLE ENERGY ACTION PLAN (SEAP) AND GHG EMISSIONS

While planning the activities within the frame of the monitoring over the implementation of Sustainable Energy Action Plan and mitigation of the emissions of greenhouse gases, great importance should be given to the responsibility of local authorities determined by the new code on local municipality as a result of the amendments made to Georgian legislation on local self governance. The Parliament approved the new Code on Self Governance on 6 February 2014. A scarcity of financial and human resources and lack of relevant technical skills should be also taken into consideration.

The process of preparing the monitoring plan should envisage several options of its fulfillment and at this stage proper distribution and strict distinction of responsibilities and duties might be the most effective both between structural units inside the municipality and with external resources; otherwise this approach means joint use of internal and external resources of Batumi municipality for the monitoring purposes.

The process of creating the action plan demonstrated that one of the key problems of Batumi, as well as all of Georgia, is access to data on energy consumption in the sectors relevant for the emission inventory of baseline year. Often there is no system for recording data and in some cases the information is not presented in a desired format, while in most cases significant time and human resources are spent to collect dat since the collection system is not organized and there are no statistical offices in place. This significantly hinders the process of creating the SEAP and could be viewed as important obstacle for the monitoring process as well.

One of the key sectors of National Communications on Climate Change, is the greenhouse gases inventory, however in this document the emissions of the following sectors are considered: energy, transport, industry, agriculture, changes in land use and waste and waste water management all over the country, while emissions from sectors such as construction, tourism, population and so on are not studied. Emissions disaggregated on municipal level are not considered or estimated either. In the process of preparation of Georgia's Third National Communicationon on Climate Change (2012-2014) particular consideration was given to this, and for 2011 emissions were calculated for the baseline year of two municipalities (Batumi and Poti). Main focus in the process of disaggregation was made on transport, buildings and waste sector.

To mitigate the risk connected with data collection, the methodology for implementing the monitoring plan should be developed by the SEAP to reduce the obstacles as much as possible. One such activities is to define the registration of the data required for baseline and reference scenarios that will be regularly used, summarized and systematized by the employees of respective offices of Batumi City Hall or the energy managers appointed particularly for this purpose by the city hall. Monitoring, reporting and verification (MRV) should be implemented without significant loss of time based on regular updating of available data.

For purposes of internal monitoring and analyses it is essential to provide the respective offices of Batumi Municipality with easy-to-use software based on BAU scenario, to calculate the emissions of baseline/reference scenario and quantities of mitigated emissions for different measures. Training local staff will be required for the effective use of such software.

The engagement of invited experts for the monitoring process will be necessary, as recognized while preparing periodical reports on implementation of the SEAP , and this at least during the first reporting stages.

The key activities considered in the process of monitoring and reporting for Batumi City are:

1. Updating the BAU scenario;
2. Estimating emissions mitigated by measures and projects implemented;
3. Preparing final reports.

The agencies responsible for this process:

1. The Municipality of Batumi City is responsible for collecting data on general parameters leading the municipality's development process (GDP, population, incomes per capita, share of economic activities/sectors in GDP). The BAU scenario could be created by external resources, but this resource should be known and accredited for this activity by the municipality. The methodology for calculation and further update of BAU scenario will be provided to the city hall within the framework of the preparation of "Low emission development strategy" by the government of Georgia and agreed by the Covenant of Mayors technical support. The emission factors to be used should be agreed with the National Focal Point of the UNFCCC (UN Framework Convention on Climate Change) and low emission development process.
2. The information gathered to calculate emissions mitigated by implemented activities and projects should be collected by a project/measure implementing unit. The municipality ensures data collection methodology for these implementers. The municipality is responsible for calculating and controlling final emissions in this case also; however this also could be done by external resources accredited by the Covenant of Mayors. Periodic verification of the data from the project implementer is the responsibility of municipality.
3. City Hall is responsible for preparing the final monitoring report and the City Council (Sakrebulo) must approve it before it is submitted to the EU.

This document provides the description of the elements of monitoring process: general parameters which should be monitored within the process of SEAP implementation, the (QA/QC) procedure for the data on activities, and the emissions factors on which the BAU scenario is updated for the following year, and calculation of mitigated emissions.

Responsible Unit in the Municipality

The division for strategic planning and economic development is responsible for preparing and implementing the Covenant of Mayors and SEAP, for its systematic update, in compliance with new conditions and new plans for development. The same division is responsible for implementation of monitoring, analyses of its results and taking these results into consideration in the process of updating SEAP, verifying the monitoring data and preparing final report, which will be approved by Batumi "Sakrebulo" prior to submission to EU. The division for strategic planning and economic development is also responsible for organizing the data collection process, facilitating to improvement of data quality, its systemic update and identifying new sources. In this process the division for strategic planning and economic development can use other divisions subordinated to the municipality as well certified outside resources.

Five key sectors are discussed within the SEAP: energy consumption of buildings, transport sector, street lightening, waste and waste water treatment and greening of city. Monitoring the data of different activities described below, are required for evaluating a BAU scenario of each sector. Besides the data of these activities the monitoring will be necessary within the framework of each implemented project and activity, based on which the emission scenario will be assessed and total reductions will be verified against the BAU scenario that was established. The quantity of total mitigated emissions will be defined on the basis of analyses of the results of the comparison of above mentioned.

The responsibility for collecting statistical materials for monitoring each sector could be assigned to respective structures in the city hall, and a second option viewed by the city hall is that archiving and quality control (QC) of the data could be done in a regional centre for energy efficiency and innovations, which could be hosted by Batumi City. The divisions of the city hall and Ltd or IP to be responsible for data collection are provided below:

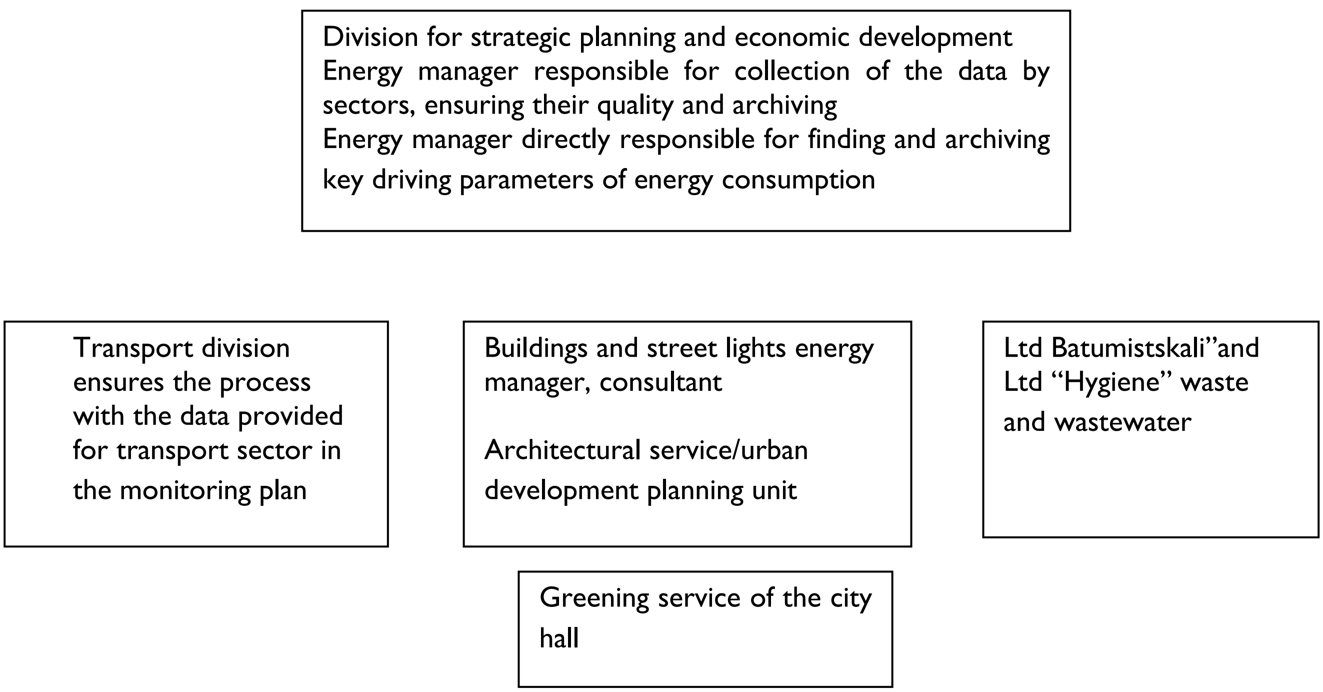

Figure 28. Managing the Monitoring Process

The data of four types will be collected and assessed for preparing monitoring report for each sector: annual emission in CO2 equivalents, the status of implementing the activities and projects and saved emissions, main driving parameters of BAU scenario (for example for transport sector these are:

population, GDP or increase of revenues and distribution of passenger kilometers by transport modes) and economic and social effects of implemented activities.

The SEAP monitoring group certified by Batumi municipality will be responsible for preparing an annual monitoring report, which will be submitted every two years (compiled analyses of 2 years) to a third party for verification. Presumably this third party will be provided by the Covenant of Mayors office. The structure of monitoring will be created by the monitoring group and it should not contradict the general format of monitoring elaborated and provided by the Covenant of Mayors.

It is expected that new approaches and methodologies will be implemented gradually to perfect the monitoring and make it uniform so that the BAU scenario is comparable by all years.

Monitoring Reference Scenario Drivers[23]

These parameters are monitored in order to track the significant changes and reassess the impact of changes on the reference scenario during the reporting period. In case SEAP is revised and relevant reference scenarios updated, the driving parameters should be applied.

Driving parameters of Business As Usual (BAU) scenario and different sectors:

Data / Parameter: # 2.1	**Number of population in monitoring year**
Data unit:	Population size
Description:	Primary data[24]; Monitored annually.
Source of data used:	Statistical yearbook (www.Geostat.ge) and local statistics
Value applied:	169 400 (Municipality of Batumi city)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	For Batumi the future forecast of population increase was provided by the Municipality of Batumi City.

Data / Parameter: #2.2	**GDP (Gross Domestic Product) in 2012**
Data unit:	Million GEL
Description:	Primary data; Monitored annually.
Source of data used:	Current value of GDP and future forecast is provided by local authorities, by the Ministry of Finance and Economy of Ajara.
Value applied:	2012- 849.45
Justification of the choice of data or description of	

[23] This monitoring plan was prepared for Batumi city SEAP and used monitoring format developed by the UNFCCC CDM (Clean Development Mechanism) Secretariat.

[24]Data considered as primary if it is not calculated by the "Monitoring Agency" but is derived from different sources.

measurement methods and procedures actually applied :	
Any comment:	

Emission Factor (EF)

Data / Parameter: #2.3	**Electricity (Georgia's grid EF) CO2**
Data unit:	T CO2/MWh
Description:	Secondary data[25]. Should be calculated for whole country and provided to the municipalities.
Source of data used:	Calculated especially for this SEAP by a simple average method when emissions from generation of electricity is divided by overall electricity generation.
Value applied:	0.136
Justification of the choice of data or description of measurement methods and procedures actually applied :	The grid emission factor is calculated as average emission of country's power sector per generated kwh.
Any comment:	This emissiona factor is calculated for all of Georgia to monitor the Low Emissions Development Strategy and supplied to municipalities from central government.

Data / Parameter: #2.4	**Emission factor of natural gas (NG)**
Data unit:	T CO_2/TJ, kg CO_2/TJ
Description:	Primary data
Source of data used:	IPCC default (for tier 1)
Value applied:	55.78 t CO_2/TJ; 5 kg CH_4/TJ; 0.1 kg N_2O /TJ.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be systematically updated. When country specific values are available then country specific factors will be used.

Data / Parameter: #2.5	**Gasoline**
Data unit:	t/TJ, kg/TJ
Description:	Primary data; IPCC default (for tier 1)
Source of data used:	68.6 t CO_2/TJ; 20 kg CH_4/TJ; 0.6 N_2O kg/TJ.

[25]Data considered as secondary if it is calculated by the "Monitoring Agency".

Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be systematically updated. When country specific values are available then country specific factors will be used.

Data / Parameter: #2.6	**Emissions factor for Diesel**
Data unit:	t/TJ, kg/TJ
Description:	Primary data; IPCC default (for tier 1)
Source of data used:	73.3 t CO_2/TJ; 5 kg CH_4/TJ; 0.6 kg N_2O /TJ.
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be systematically updated. When country specific values are available then country specific factors will be calculated.

Data / Parameter: #2.7	**NCV (for NG, gasoline, diesel)**
Data unit:	
Description:	Primary data. This value should be acquired at the national level.
Source of data used:	Exporters and distributors of NG and fossil fuel.
Value applied:	NG- 33.59 TJ/million m^3; Petrol - 44.80 TJ/1000 t; Diesel -43.33 TJ/1000 t; Wood – 7.50 TJ/ 1000 m^3. (IPCC default values)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be systematically updated. When country specific values are available then country specific emission factors will be calculated.

Data to be monitored for the transport sector of Batumi city

Data to be monitored for public buses

Data / Parameter: #3.1	**Number of public buses (public transport) by type**

Data unit:	Vehicles (buses) in monitoring year
Description:	Primary data
Source of data used:	Bus service provider enterprise “BatumisAvtotransporti” Municipality of Batumi City, Department of transport (alternative source)
Value applied:	**130**(130 diesel)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Municipality of Batumi City, Department of transport will be responsible to monitor and provide annual number of buses travelled in the city to the monitoring agency. Monitoring agency should independently verify (cross-check) these data based on fuel consumption received from the financial department of the Municipality.

Data / Parameter: #3.2	**Total annual distance travelled by one bus by bus type and fuel type**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Bus service provider “Batumi Avtotransporti” Municipality of Batumi City, Department of transport (alternative source)
Value applied:	**40 000** Km/year
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Municipality of Batumi City, Department of Transport will be responsible to monitor and provide annual data to the monitoring agency. Monitoring agency should independently collect these data from the bus service providers at the monthly bases. Monitoring agency should independently verify (cross-check) these data based on fuel consumption received from the financial department of the Municipality. Bus service provider “BatumisAvtotransporti” should submit data on annually travelled distance by each bus type and by fuel type. However, alternative is to submit total annual distance covered by all buses from an entity. This parameter could be randomly cross-checked through fuel coupons issued per route per bus.

Data / Parameter: #3.3	**Average fuel consumption per 100 km by a bus using diesel, petrol or natural gas**
Data unit:	Litre/100km
Description:	Secondary (calculated actual consumption through total fuel consumed and actually run distance) Primary (from manufacturer’s specification)
Source of data used:	Calculated during the monitoring

Value applied:	23 Litre/ 100km- diesel
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Actual meaning of this parameter will be calculated by the "Monitoring Agency" based on data provided by the bus service provider companies. Primary meaning will be derived from the manufacturer's specifications for further cross-checking.

Data / Parameter: #3.4	**Bus load factor**
Data unit:	Passenger per vehicle
Description:	Primary.
Source of data used:	surveys
Value applied:	Has not been used.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be necessary for monitoring.

Data / Parameter: #3.5	**Total annual fuel consumption by fuel type (petrol, diesel, NG) by all buses operating in Batumi city**
Data unit:	Litre/year
Description:	Secondary (should be calculated by monitoring unit)
Source of data used:	For SEAP was provided by the Batumi municipality
Value applied:	1.196 million liter diesel
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This parameter will be cross checked against the data on fuel consumption provided by the bus service providers and data from the department of statistics and finance if available. Transport department of the municipality also to monitor this parameter.

Data / Parameter: #3.6	**Total annual passenger turnover by buses**
Data unit:	passenger/year
Description:	Primary data
Source of data used:	For SEAP was provided by the Batumi municipality.
Value applied:	**Not used, necessary for monitoring**
Justification of the	

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This parameter has different independent sources listed above. It is monitored for different (particularly for economic activity) purposes. These sources will allow to cross-check the data provided by each source. One of the sources is annually sold tickets.

Mini Buses

Data / Parameter: #3.9	**Number of mini buses operating annually**
Data unit:	Vehicle/per year
Description:	Primary data
Source of data used:	Mini bus service providers. Seven different companies have provided this information which are considered as primary sources in future monitoring. Municipality of Batumi City, Department of transport could be considered as alternative source.
Value applied:	**650 (diesel)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Municipality of Batumi City, Department of transport will be responsible to monitor and provide annual data to the monitoring agency. Monitoring agency should independently collect these data monthly from the mini bus service providers and cross check with fuel.

Data / Parameter: #3.10	**Average annual distance travelled by one mini-bus by fuel type**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Mini bus service providers. Seven different companies have provided this information which are considered as primary sources in future monitoring. Municipality of Batumi City, Department of transport could be considered as alternative source.
Value applied:	**60 000 km/year**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Municipality of Batumi City, Department of transport will be responsible to monitor and provide annual data to the monitoring agency. Monitoring agency should independently collect these data monthly from the mini bus service providers and cross check with fuel.

Data / Parameter: #3.11	**average fuel consumption by fuel type (petrol, diesel, NG) by all mini buses operating in Batumi city.**
Data unit:	Litre/100 km
Description:	Primary data
Source of data used:	Mini bus service providers Transport Department of the Municipality of Batumi
Value applied:	14 Litre/ 100 km diesel
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected monthly from the mini-bus service provider companies. Could be checked against the fuel receipts and the data available from the Transport Department of the Municipality gathering these data for economical purposes.

Data / Parameter: #3.4	**Bus load factor**
Data unit:	Passenger per vehicle
Description:	Primary.
Source of data used:	surveys
Value applied:	Has not been used.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be necessary for monitoring.

Data / Parameter: #3.14	**Annual fuel consumption by all mini buses (by fuel)**
Data unit:	Litre/year; m3/ year
Description:	Secondary data
Source of data used:	For SEAP was provided by the Batumi municipality.
Value applied:	5265 000 Litre diesel
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Calculated by the monitoring agency. Could be cross checked against the data from the Transport Department of the Municipality gathering these data for economical purposes and from the department of statistics.

Data / Parameter:	**Total annual passenger turnover(mini buses)**

#3.15	
Data unit:	Passenger/year
Description:	Calculated
Source of data used:	For SEAP was provided by the Batumi municipality.
Value applied:	**Not used**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Companies provided mini-buses service should provided number of passengers based on tickets sold, which could be later cross-checked against the information from financial unit.

Private cars

Data / Parameter: #3.18	**Number of passenger cars (registered in Batumi) by fuel**
Data unit:	vehicle
Description:	Primary data
Source of data used:	Ministry of Internal Affairs of Georgia, Patrol Department of Ajara. Batumi municipality provided data for this SEAP preparation.
Value applied:	**19,250 petrol, 2800 diesel, 25 electricity, 1450 NG**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #3.19	**Average annual distance traveled per car**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Average annual distance driven per car. Average per day driving distance should be estimated through survey and by expert judgment. Survey should be statistically accurate. This value applied in this SEAP is provided by the transport unit of the Batumi municipality
Value applied:	**7 000**km (6300 km)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	A more careful survey should be conducted during SEAP implementation

Data / Parameter:	**Load factor**

#3.20	
Data unit:	pass-km/veh-km
Description:	Primary
Source of data used:	Different studies could be used. In parallel survey should be conducted by the monitoring Agency in accordance with the methodology provided by the National Statistic Office. This value applied in this SEAP is provided by the transport unit of the Batumi municipality.
Value applied:	Not used
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #3.23	**Fuel Consumption per 100 km by type of car and type of fuel**
Data unit:	L/100 km m^3/100 km kWh/100 km
Description:	Primary data
Source of data used:	These data are mainly from technical passport of cars.
Value applied:	**Petrol-12l/100 km** **Diesel -12 l/100 km** **NG -7.5m^3/100 km**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This data is cross-checked through surveys and data by type of fuel and by type of cars are archived in COPERT database.

Municipal cars and other cars used by governmental structures

Data / Parameter: #3.24	**Number of municipal cars and other cars used by governmental structures**
Data unit:	Number of vehicle
Description:	Primary data
Source of data used:	Transport department of the Municipality; Other departments of the Municipality owing municipal transport Ministry of Internal Affairs, Patrol Department of Ajara
Value applied:	**Petrol -78** **Diesel - 15**
Justification of the	

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #3.25	**Average annual distance travelled by one car by fuel type**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Transport department of the Municipality; Surveys conducted by different sources and among them by the monitoring agency
Value applied:	**8 000 (5600)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #3.26	**Fuel consumption on 100km per car by fuel type**
Data unit:	Litre/100 km
Description:	Primary data
Source of data used:	Transport department of the Municipality; Manufacturer's specification.
Value applied:	**Petrol - 8** **Diesel – 10**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #3.27	**Total average annual fuel consumption by municipal cars by fuel type**
Data unit:	Liter (Mwh)
Description:	Secondary data
Source of data used:	Should be calculated by monitoring Agency. For this SEAP it is estimated by the transport unit of Batumi municipality
Value applied:	8400 -Diesel 35000 - Petrol
Justification of the choice of data or description of measurement methods	

and procedures actually applied :	
Any comment:	

Commercial transport (taxi, light-duty and heavy-duty vehicle)

Data / Parameter: # 3.28	**Number of commercial vehicles**
Data unit:	According to the vehicle type and fuel
Description:	Primary data
Source of data used:	Ministry of Internal Affairs of Georgia and patrol department of Ajara. For this SEAP transport unit of Batumi municipality provided the data.
Value applied:	**taxi - 1285** **light duty -475** **heavy duty - 310**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected annually by the monitoring agency.

Data / Parameter: # 3.29	**Average annual distance run by commercial cars by types**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Ministry of Internal Affairs of Georgia and patrol department of Ajara. For this SEAP transport unit of Batumi municipality provided the data.
Value applied:	**Taxi –50 000 km (35 000 km)** **Light duty –30 000 km (18 000 km)** **Heavy duty –15 000 km (10 500 km)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Verification of this data is the responsibility of transport unit of Batumi municipality.

Data / Parameter: # 3.30	**Annual turnover of passengers and goods**
Data unit:	passengers/year; tons/year
Description:	Primary data
Source of data used:	NSO of Georgia. Responsible for monitoring of this parameter is transport unit of Batumi municipality which has provided current data for SEAP preparation.
Value applied:	**Not used**
Justification of the	

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Was calculated as the difference between a total diesel consumption in Tbilisi and consumption by municipal and public transport cars.

Data / Parameter: #3.32	**Fuel consumption on 100 km per car by fuel type**
Data unit:	Litre/100 km m^3/100 km
Description:	Primary data
Source of data used:	Transport department of the Municipality; Ministry of Internal Affairs Manufacturer's specification.
Value applied:	**Taxi: petrol 8 l; diesel 8 l; NG 7 m3** **Light duty: petrol 14 l; diesel 14 l.** **Heavy duty- petrol 25 l; diesel 25 l.**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected annually by the monitoring agency and cross-checked with the manufacturer's specifications.

Data / Parameter: #3.33	**Annual fuel consumption**
Data unit:	Litre/100 km (MWh) m^3/100 km (MWh)
Description:	Secondary data
Source of data used:	Calculated by the monitoring team.
Value applied:	**Taxi – gasoline 1.7 mln liters, diesel 1.3 mln liters and CNG 227.5 thousand cubic meters** **Light Commercial Vehicles – gasoline 126 thousand liters, diesel 1 million liters** **Heavy vehicles – diesel 814 thousand liters.**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Some sectors could be cross checked against the fuel reporting forms, others could be assessed jointly with the transport unit of Batumi municipality.

Data / Parameter: #3.34	**Annual fuel consumption in Batumi by transport sector**

Data unit:	Litre/100 km (MWh) m^3/100 km (MWh)
Description:	Primary data
Source of data used:	Sum of fuel consumed by different transport modes
Value applied:	Diesel – 16.5 mln liters, Diesel 11.8 mln liters and CNG 913 thousand cub.m
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Very important parameter for establishment of balance.

Waste management and wastewater treatment

Data / Parameter: #4.1	**Amount of daily incoming wastewater**
Data unit:	m^3/day
Description:	Primary parameter
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for monitoring this parameter.
Value applied:	58 000 ∂^3/day in dry periods; 60 000-84 000 ∂^3/day in rainy periods.
Justification of the choice of data or description of measurement methods and procedures actually applied :	During preparation of SEAP this parameter was not applied for estimation of generated methane amounts. General amounts of COD (Chemical Oxygen Demand) and BOD (Biological Oxygen Demand) were already calculated and provided by "BatumisTskali". In future, the monitoring of this parameter is obligatory for cross checking the data.
Any comment:	

Data / Parameter: #4.2	**COD and BOD in incoming wastewater (desirable to be measured both of these parameters for QC).**
Data unit:	mg/l
Description:	Primary parameter
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	250-300 mg/l (COD) 90 mg/l (BOD)
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value/parameter is not applied during the preparation of Batumi SEAP. For this SEAP the daily load of wastewater concentration by COD/BOD measured periodically (5 times) during the day was provided by "Batumi Tskali".

Any comment:	

Data / Parameter: #4.3	**COD and BOD in outgoing wastewater (desirable to be measured both of these parameters for QC).**
Data unit:	mg/l
Description:	Primary parameter
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	30-60 mg/l (COD) 10 mg/l (BOD)
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value/parameter was not applied during the preparation of Batumi SEAP. For this SEAP the daily load of outlet wastewater concentration by COD/BOD measured periodically (5 times) during the day was provided by "Batumi Tskali".
Any comment:	

Data / Parameter: #4.4	**Wastewater COD and BOD concentration at the pumping stations (collectors A and B)**
Data unit:	mg/l
Description:	Primary parameter (measured monthly).
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	No data
Justification of the choice of data or description of measurement methods and procedures actually applied :	This parameter is not directly used in calculations but is necessary for cross checking of directly applied parameters. In addition this parameter is very important for establishment of BAU scenario in this sub-sector.
Any comment:	

Data / Parameter: #4.5	**COD and BOD in incoming wastewater (preferable both to be measured for cross-checking). Wastewater concentration load measurement approach.**
Data unit:	kg/day
Description:	Secondary parameter, calculated by multiplying the amount of daily received wastewater by 5 times per day measured COD/BOD concentration
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	**15 000** kg/day (COD) **6 046**kg/day (BOD)
Justification of the choice of data or description of measurement methods	Above values are provided by "Batumi Stkali" and are used for preparation of this SEAP.

and procedures actually applied :	
Any comment:	

Data / Parameter: #4.6	**COD and BOD in treated outgoing wastewater (preferable both to be measured for cross-checking). Wastewater concentration load measurement approach.**
Data unit:	kg/day
Description:	Secondary parameter, calculated by multiplying the amount of daily received wastewater by 5 times per day measured COD/BOD concentration
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	**2 400**kg/day (COD) **1097**kg/day (BOD)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Above values are provided by "Batumi Stkali" and are used for preparation of this SEAP. This is total load measured once in 5 days. Preferable to measure both (COD and BOD) for cross-checking.
Any comment:	

Data / Parameter: #4.7	**Methane generation standard potential (B_0)**
Data unit:	kg CH_4/kgCODor kg CH_4/kg BOD
Description:	Primary parameter. IPCCdefault values are applied.
Source of data used:	IPCC, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000 (page. 5.24), http://www.ipcc-nggip.iges.or.jp/public/gp/english/5_Waste.pdf
Value applied:	**0.6 kg** CH_4/kg BOD **0.25 kg** CH_4/kg COD
Justification of the choice of data or description of measurement methods and procedures actually applied :	**0.6 kg** CH_4/kg BOD was applied in this SEAP.
Any comment:	

Data / Parameter: #4.8	**Methane conversion Factor (MCF)**
Data unit:	N/A
Description:	Primary parameter for which the IPCCdefault values are applied.
Source of data used:	Table 6.3, Chapter 6, vol.5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	**0.8** applied for Batumi wastewater treatment system with open sludge lagoons

	Will be applied when sludge lagoon will be covered , making system more anaerobic.
Justification of the choice of data or description of measurement methods and procedures actually applied :	This SEAP used MCF= 0.8 because sludge lagoons are open with depth more than 2 m. In case of pilot project implementation these lagoons will be covered and MCF=1 should be applied.
Any comment:	

Data / Parameter: #4.9	**Annual generation of methane in the sludge lagoons of the Batumi city wastewater treatment system**
Data unit:	t CH_4
Description:	Secondary parameter
Source of data used:	Should be calculated by monitoring unit
Value applied:	**WM= Σi (TOWi • EFi)** **WM** – total annual methane generated annually by wastewater treatment process kg CH4; **TOWi** – kg BOD in i type (industrial, residential, etc) wastewater kg BOD/year; EFi – EF (emission factor) of i type wastewater, kgCH4/kg BOD; **EFj= Bo ·MCFj** EFj – Emission Factor when treating water by j type of treatment system (kgCH4/kgCOD); j- type of wastewater treatment system; Bo – Maximum standard capacity of methane generation from wastewater, Bo=0.25 kgCH4/kgCOD. MCFj – Methane Correction Factor. MCFj for Batumi equals to 0.8.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #4.10	**Generated electricity or produced CNG (Compressed Natural Gas)**
Data unit:	kWh or m^3 relevantly
Description:	Primary parameter, measured at the point of generation or compressing. Parameter will be measured by "BatumisTskali" . .
Source of data used:	
Value applied:	This parameter should be monitored in case of implementation of methane reduction proposal. Details of measurement equipment and calibration procedure will be designed in the proposal.
Justification of the choice of data or description of	

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #4.11	**Consumed electricity or consumed CNG**
Data unit:	kWh or m^3
Description:	Primary parameter calculated at the delivery point. It should be measured and provided by the grid operator or fueling station operators. Monitoring of this parameter is responsibility of "BatumisTskali". This entity has to cross-check provided data against financial operations (income, etc).
Source of data used:	N/A
Value applied:	This parameter will be monitored in case of project implementation and in case if captured methane is not only flared but used for generation of electricity or CNG and more carbon rich fuel is substituted. In case of replacement of power or other energy sources will be accounted by the Batumi city for SEAP implementation this parameter must be monitored or upon the request of donors.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #4.12	**Amount of waste (already disposed and daily delivered) Old landfill**
Data unit:	m^3or tons
Description:	Primary parameter.
Source of data used:	For this SEAP data were provided by the Directorate of Environment and Natural Resources Protection of Ajara. In case of project implementation Ltd "Hygiene" will be responsible for monitoring data. Recently "Hygiene" considered as potential project implementer, responsible for landfill management.
Value applied:	Monitoring of solid waste amount disposed on this existing landfill started in 1990. 700-850 m^3SW is disposed daily. Total amount of SW disposed at the landfill by 2012 is estimated as 9,407,419 m^3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This landfill is in operation and envisaged to be closed in 2015 when new landfill opened. Maximum future 30 years methane will continue to be emitted to the atmosphere. However, for the purpose of conservation the proposal prepared for methane capture and utilization from this old landfill considers only next 15 years. After 15 years methane could be only flared due to

	insignificant amounts.

Data / Parameter: #4.13	**Characteristics of existing landfill (area, depth, composition of waste)**
Data unit:	Area-ha Depth -m Composition of waste -%
Description:	Primary parameter. After closing the landfill monitoring of this parameters is not obligatory.
Source of data used:	For this SEAP data were provided by the Directorate of Environment and Natural Resources Protection of Ajara. In case of project implementation Ltd "Hygiene" will be responsible for monitoring data. Recently "Hygiene" considered as potential project implementer, responsible for landfill management.
Value applied:	Area -19.2 ha Depth - 7 m (average) Waste composition: food product 63%, textile 11%, paper 8%, polyethylene - 7% and other 11%
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is necessary only for assessment of annual potential of methane generation.
Any comment:	This landfill is still in operation and to be closed in 2015 when new landfill will be opened. Maximum future 30 years methane will continue to be emitted to the atmosphere. However, for the purpose of conservativeness the proposal prepared for methane capture and utilization from this old landfill considers only next 15 years. After the 15 years methane could be only flared because of insignificant amount.

Data / Parameter: #4.14	**Annual delivery of solid waste to the new landfill**
Data unit:	m^3or tons
Description:	Primary parameter.
Source of data used:	For this SEAP data were provided by the Directorate of Environment and Natural Resources Protection of Ajara. In case of project implementation Ltd "Hygiene" will be responsible for monitoring of data. Recently "Hygiene" considered as potential project implementer and responsible for landfill management.
Value applied:	It is tentatively estimated that initially daily delivery and disposal of SW to the landfill site will be 42 000 t annually, but later it should reach 80 000 tons annually.
Justification of the choice of data or description of measurement methods and procedures actually applied :	

Any comment:	This new landfill is planned to commence operation in 2015 when new landfill facility is constructed in compliance with 999/31/EC. Significant emissions from this landfill will start most likely after 3-4 years when operation starts. It is envisaged to be started in 2019.

Data / Parameter: #4.15	**Characteristics of new landfill (area, depth, waste composition)**
Data unit:	area -ha depth -m waste composition -%
Description:	Primary parameter. Waste composition and density should be periodically monitored no less than biannually.
Source of data used:	For this SEAP data were provided by the Directorate of Environment and Natural Resources Protection of Ajara. In case of project implementation Ltd "Hygiene" will be responsible for monitoring of data. Recently "Hygiene" considered as potential project implementer and responsible for landfill management.
Value applied:	Area - 32 ha Depth - 12 m Composition of waste (recent composition): food product- 63%, textile- 11%, paper- 8%, polyethylene 7% and others 11%
Justification of the choice of data or description of measurement methods and procedures actually applied :	This parameter are necessary for calculation of annual methane generation
Any comment:	It is planned that this landfill will be in operation in 2015.

Data / Parameter: #4.16	**Calculation of generated methane**
Data unit:	m^3or tons
Description:	Secondary parameter. Should be calculated by First Order Decay (FOD) model. Calculations under the responsibility of monitoring group/unit
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl (page. 3.36). This is software programme requesting the landfill characteristics as input parameters.
Value applied:	Parameters required for calculation: • Waste composition • Methane Correction Factor (MCF) -1 • Degradable Organic Carbon (DOC) Food waste 0.15 garden 0.20 Paper 0.40 Trees and grass 0.43 Textile 0.2

	4 Hygienic 0.2 papers 4 • Factually degraded part of DOC (DOCF)-0.5-0.6 • Methane share in landfill gas (F)-50% • Oxidation factor (OX)-0.1 (for managed landfills)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	In case of implementation of methane capture and extraction project this generated amount of methane should be measured as well as energy generated from this methane (in case of generation).

Street lightening

Data / Parameter: #5.1	**Electricity annually consumed in street lightening**
Data unit:	kWh/year
Description:	Primary data
Source of data used:	Infrastructure development unit of the municipality of Batumi city. This unit is responsible for providing monthly/annual consumption of electricity in street lightening.
Value applied:	**12 810 658 kWh (in 2012)** **16 100 000 kWh (in 2020)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be cross-checked against the payments made for street lightening.

Data / Parameter: #5.2	**Number of old/ low-efficiency lamps replaced with (LED) lamps,**
Data unit:	Number of replaced lights
Description:	Primary parameter
Source of data used:	Project/measures implemented unit
Value applied:	65% of existing lamps will be replaced by 2020 7300 new LED lamps will be installed by 2020.
Justification of the choice of data or description of measurement methods and procedures	

actually applied :	
Any comment:	Replaced bulbs should be tracked and transparently monitored as to how they are used in future: are they destroyed in order to ensure that they are not any more used or they are installed somewhere else?

Data / Parameter: #5.3	**Energy saved by one LED lamp per hour**
Data unit:	kWh
Description:	Primary parameter
Source of data used:	Technical passport of LED lamp.
Value applied:	**0.236**kWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Could be cross checked against random measurements.

Data / Parameter: #5.4	**Emission reduced due to implementation of EE measure (LED)**
Data unit:	$tCO_{2eq.}$
Description:	Secondary parameter. Calculated annually by the monitoring unit.
Source of data used:	Estimated by the group working on SEAP
Value applied:	Estimated reduction in 2020 is **1700**tCO_2-ის
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Green spaces of Batumi city

Data / Parameter: #6.1	**Annual planting and survival of plants by species**
Data unit:	ha Area of plants by types
Description:	Primary parameter
Source of data used:	Batumi city greening service and Batumi Boulevard greening service
Value applied:	Due to non-availability of annual greening action plan for the city the following assumption was made: 1 ha annual planting starting from 2014 with 100 % survival
Justification of the choice of data or description of measurement methods and procedures actually applied :	

Any comment:	

Data / Parameter: #6.2	**Annual cuttings by species**
Data unit:	m^3
Description:	Primary parameter
Source of data used:	Batumi city greening service and Batumi Boulevard greening service
Value applied:	Only carbon stock and annual removal by 2020 on the territory of Batumi city is estimated in this SEAP. Cuttings will be monitored after implementation during monitoring
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #6.3	**Annual fires and volume of trees (number of trees) damaged by other factors (diseases, etc)**
Data unit:	m^3
Description:	Primary parameter
Source of data used:	Batumi city greening service and Batumi Boulevard greening service
Value applied:	Only carbon stock and annual removal by 2020 on the territory of Batumi city is estimated in this SEAP. The volume of trees reduced because of fires, diseases or other non-anthropogenic causes will be monitored at the implementation stage.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #6.4	**Monitoring on the territory of Botanical Garden**
Data unit:	ha
Description:	Primary parameter
Source of data used:	Authorities of Botanical Garden
Value applied:	108 ha Current status of carbon stock and annual removals are assessed for Botanical Garden territory in the SEAP and forecast by 2020 without cuttings. Actual cuttings will be monitored during implementation.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	There are no planned cuttings on the territory of Botanical Garden.

Data / Parameter: #6.5	**Annual fires and volume of trees (number of trees) damaged by other non-anthropogenic causes (diseases, etc) on the territory of Botanical Garden**
Data unit:	m^3
Description:	Primary parameters
Source of data used:	Authority of Botanical Garden
Value applied:	Current status of carbon stock and annual removals are assessed for Botanical Garden territory in the SEAP and forecast by 2020 without considering natural disturbances. Real changes in biomass caused by the natural disturbances will be monitored during implementation.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #6.6	**Annual calculation of carbon stock changes**
Data unit:	tCO2/year
Description:	Secondary parameter will be calculated by monitoring unit.
Source of data used:	Will be calculated by the SEAP monitoring unit
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Building sector

Data / Parameter: #7.1	**Annual consumption of electricity by municipal buildings**
Data unit:	MWh/year
Description:	Primary parameter (measured)
Source of data used:	Financial unit of Batumi municipality. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**18 520.1**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Data should be cross-checked against the source such as Energo-Pro (distributor company).

Data / Parameter: #7.2	**Annual consumption of electricity by residential buildings**
Data unit:	MWh/year
Description:	Primary parameter (measured)
Source of data used:	Energo-Pro (distributor company). Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**141 368.8**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	These data could be cross checked by survey of typical residential buildings.

Data / Parameter: #7.3	**Annual consumption of electricity by commercial buildings**
Data unit:	MWh/year
Description:	Primary parameter (measured)
Source of data used:	Energo-Pro (distributor company). Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**85 754.8**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	These data could be cross checked by survey of typical commercial buildings.

Data / Parameter: #7.4	**Annual consumption of NG and LPG by municipal buildings**
Data unit:	m^3/year, Ton
Description:	Primary parameter (measured)
Source of data used:	Financial unit of Batumi municipality. Energy manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**NG- 181 125 m^3/year** **LPG- 7.8 ton**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Data should be cross-checked against the data from distributor company.

Data / Parameter: #7.5	**Annual consumption of NG and LPG by residential buildings**
Data unit:	m^3/year, Ton/year
Description:	Primary parameter (measured)

Source of data used:	Gas distributor company (Socar). Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**NG- 16 351 625m³/year** **LPG- 5098 Ton**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	These data could be cross checked by survey of typical residential buildings.

Data / Parameter: #7.6	**Annual consumption of NG by commercial buildings**
Data unit:	MWh
Description:	Primary parameter (measured)Reported annually.
Source of data used:	Gas distributor company (Socar). Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**26 958.7 (NG in MWh)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	These data could be cross checked by survey of typical commercial buildings.

Data / Parameter: #7.7	**Annual consumption of wood by municipal buildings**
Data unit:	m³/year
Description:	Primary parameter (measured)
Source of data used:	Financial unit of Batumi municipality. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**wood- 110 m³/year**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #7.8	**Annual consumption of wood by residential buildings**
Data unit:	m³/year
Description:	Primary parameter (measured)
Source of data used:	Vouchers issued or population/households. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**wood- 29 890 m³/year**

Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be cross checked through periodic surveys of population. Recently, actual consumption is higher than official vouchers issued (illegal cuttings).

Data / Parameter: #7.9	**Annual consumption of diesel and wood by commercial buildings**
Data unit:	m^3/year, l/year
Description:	Primary parameter (measured)
Source of data used:	Survey of commercial buildings. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	Recently (in 2012), consumption of any of these fuels is not reported. This parameter should be anyway included in the monitoring plan.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #7.10	**Monitoring of annual CO_2 emission from these three type of buildings**
Data unit:	t CO_2/year
Description:	Secondary parameter. Reported annually.
Source of data used:	Should be calculated by the monitoring unit/group
Value applied:	**2012- 87 782**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #7.11	**Energy savings from the measures implemented in the building sector**
Data unit:	MWh/per measure
Description:	Secondary parameter. Calculated per measure.
Source of data used:	Project/measures implementer (population. municipality, apartment buildings, manager of commercial building.
Value applied:	This parameter will be calculated or assessed for each project/measure implemented.

Justification of the choice of data or description of measurement methods and procedures actually applied :	For each project/measure specific monitoring plan should be developed for monitoring of energy savings and CO_2.
Any comment:	Reduction in energy consumption could happen for different reasons (technical cuts, commercial cuts, etc) and therefore very careful and transparent monitoring is required for demonstration that reduction in consumption is the result of energy-saving measures and not due to technical failures. Details of monitoring will be described in measure specific monitoring plan.